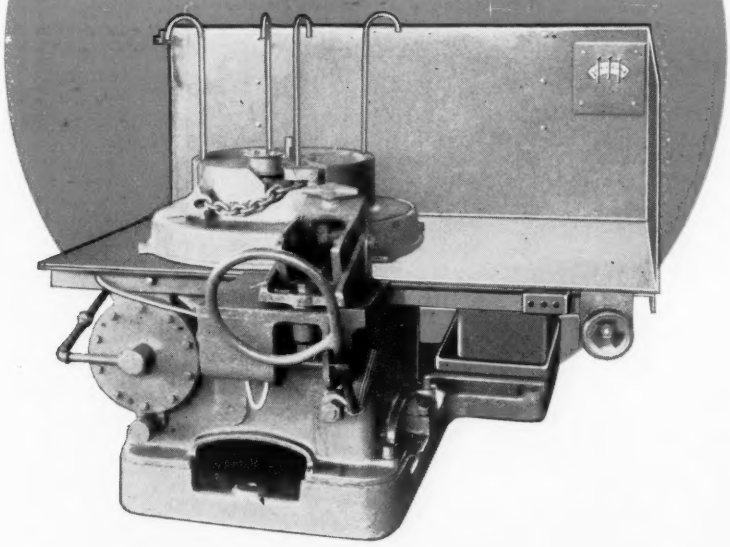
WIRE & WIRE PRODUCTS

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

VAUGHN



M • O • T • O • B • L • O • C

A universal machine that meets every requirement of the trade --- useful today, tomorrow or ten years from now.

---An important factor to remember about the MOTOBLOC when buying new or extending your present Wire Drawing Equipment.

THE VAUGHN MACHINERY COMPANY, Cuyahoga Falls, Ohio

Manufacturers of Complete Wire Drawing Equipment (Continuous or Single Hole) for the largest bars . . . . for the smallest wire . . . . ferrous, non-ferrous materials or their alloys.

July 1933

The Mark of CARBOLOY
REG. U. S. PAT. OFF.

COMPLETE CEMENTED CARBIDE DIE AND TOOL SERVICE FOR THE WIRE AND TUBE INDUSTRY

Carboloy Company, Inc., is a complete manufacturing and service organization supplying all types of cemented carbide dies and tools for use in the wire and tube industry. Service offices in 6 key cities are maintained with experienced engineers and operators available for prompt installation and service work in mills throughout the eastern and midwestern states.

Mobile Service Unit Operating in Pittsburgh Territory

Portable Service Equipment

Portable equipment can be brought into any eastern or midwestern mill for practical die manufacturing or service work or for instruction of your die room in correct Carboloy-die, service methods.

TOOLS

Tools for Your Rolling Mill—Carboloy cemented carbide tipped tools for turning and necking hard, chilled iron rolling mill rolls substantially reduce machining time on these difficult-to-machine rolls.

Truing Tools for Dressing Grinding Wheels — New, diamond-impregnated Carboloy truing tools for finish dressing grinding wheels. Equals or surpasses results obtained from single diamonds and reduces truing tool costs at least 25 per cent.

Recommended for general maintenance machining work.

Carboloy Tool Manufacturing Kit—Reduce tool and machining costs on miscellaneous shop work such as maintenance of bronze bushings, cast iron and steel parts, etc. Kit contains complete parts and accessories for making your own Carboloy tools as required. Lowest investment cost. Tool parts can be varied to meet special requirements. Standard kit illustrated contains materials for making 4 Carboloy tools sizes $\frac{3}{8}$" sq. x $2\frac{1}{2}$", $\frac{1}{2}$" sq. x $3\frac{1}{2}$", $\frac{5}{8}$" sq. x 4" and $\frac{3}{8}$" x $1\frac{1}{4}$" x 8". Shanks milled and recessed for either right or left hand use.
Cost complete, with brazing accessories, $28.50

CARBOLOY COMPANY, Inc.

CLEVELAND	CHICAGO	DETROIT
4503 Hough Avenue	565 W. Wash'ton St.	2481 E. Grand Blvd.
HEnderson 0552	CEntral 0634	MAdison 0850
NEWARK	**PHILADELPHIA**	**PITTSBURGH**
144 Orange St.	4801 No. Broad St.	704 Second Avenue
BRanchbrook 3-4260	MIchigan 5137	COurt 1347

TUBE AND WIRE DRAWING DIES

For all types of high and low carbon steel, drill rod, brass, Bronze, copper, aluminum, zinc, monel metal, iron, nickel, gold, silver, etc.

EXTRUDING DIES

Dies for extruding all materials on which threads are to be rolled.

SIZING DIES

For sizing nuts, bullets, bushings, etc.

SHAPED DIES

Shaped dies (one piece or sectional) for drawing special shapes on bar and wire stock.

SHEET METAL DRAWING DIES

For all steps in the drawing of ferrules, eyelets, split rivets, etc.

GUIDES, ETC., FOR COILING

Spring coiling pitch tools, mandrels and guides. Coiling guides for armored wire, hose, cable or rope.

COATING DIES AND GUIDES

Dies and guides for coating welding and insulated wire.

MANDRELS

For use in tube drawing. Wide range of sizes.

EQUIPMENT FOR FINISHING AND SERVICING DIES

Carboloy service includes assistance to all customers in equipping their die rooms for finishing, servicing and recutting cemented carbide dies. Our Service Department is prepared to recommend or furnish the latest, most efficient equipment for this work. Trained operators are available to instruct your die room personnel in correct methods for Carboloy dies.

CARBOLOY

REG. U. S. PAT. OFF.

CEMENTED CARBIDE DIES AND TOOLS FOR WIRE AND TUBE INDUSTRY

Under the Provisions of the

NATIONAL INDUSTRIAL RECOVERY ACT CO-OPERATION

Between Government and Industry

For 1. THE LIMITATION OF PRODUCTION.
2. THE STABILIZATION OF PRICES.

BECOMES *MANDATORY*.

Your Trade Association Now Becomes the Means by Which You Can Present a United Front in Meeting the Many Perplexing Problems in This New Economic Situation.

Under the Auspices of THE WIRE ASSOCIATION

There Will Be a Meeting of the Representatives of the Principal Companies in the Wire Industry.

Monday, July, 17, 1933, at 10 A. M.

At The Hotel Pennsylvania, 7th Ave. and 33rd St., New York, N. Y.

To Consider the Creation of a "Code of Free Competition" As Provided for by This New Law.

+ + +

Every Company in the Industry is Requested to Have a Representative Attend.

+ + +

FULL DETAILS MAY BE OBTAINED FROM

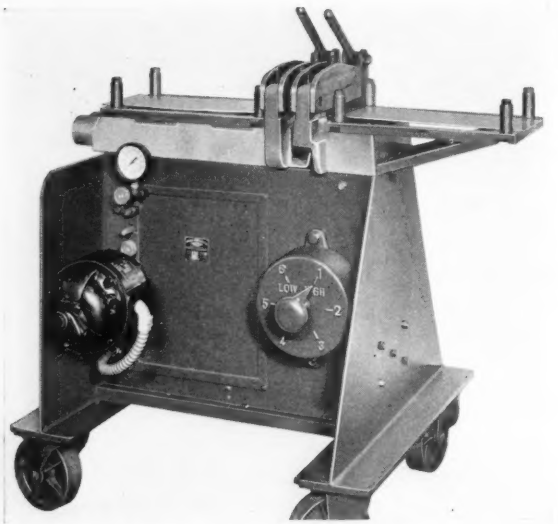
THE WIRE ASSOCIATION

17 East 42nd Street — Richard E. Brown, Secretary — New York, N. Y.

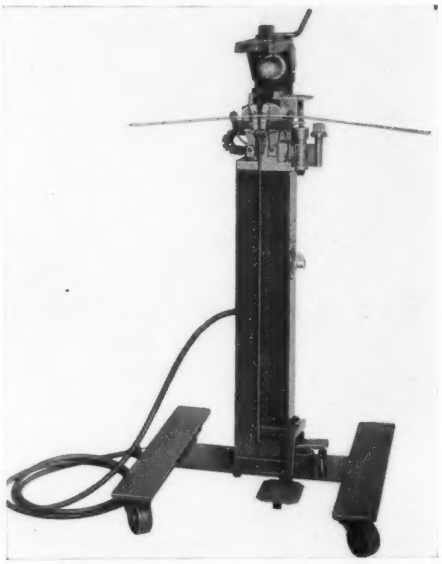
MICRO-WELD IS READY FOR THE "NEW DEAL"

With A Complete Line of New and Improved

AUTOMATIC WELDING MACHINES



Model H Hydromatic Motor Driven Flash Welder For Strip and Round Stock



Model J-3SF-Semi-Automatic Flash Welder for Strip Stock and Round or Flat Wire

MICROMETER PRECISION — MICRO-WELD TRADE MARK

Precision Welding Machines will be shown in operation at the
WIRE ASSOCIATION CONVENTION AND EXHIBITION
Detroit, Michigan, October 2nd to 6th inclusive

◆ ◆ ◆

We offer you a complete welding engineering service
Your Inquiries Solicited

◆ ◆ ◆

MICRO PRODUCTS COMPANY

114 No. Washington St., Peoria, Illinois

WIRE & WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip. Wire Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING.

Vol. 8 July 1933 No. 7

Designated as

Official Publication By The Wire Association

Contents

The Wire Drawing Die, Part I ..... By Kenneth B. Lewis 197
A study of die stresses and strains during the drawing operation.

Stresses in Helical Springs ..... By R. F. Vogt 201
A paper contributed by the Special Research Committee of the A. S. M. E. on mechanical springs. The paper suggests new formulas for calculating dimensions and stresses of helical springs.

Fatigue Tests of Helical Springs ..... By C. T. Edgerton 210
Progress report No. 2 on special committee of heavy helical springs of A. S. M. E. Special Research Committee on mechanical springs.

A Review of Recent Wire Patents 212

Imports and Exports 213

'Round the World With the Wire Industry 214

Buyers' Guide 223-224

—ASSOCIATE EDITORS—
Kenneth B. Lewis, Consulting Wire Mill Engineer
W. H. Spowers, Jr., Consultant on Galvanizing
L. D. Granger, Chief Metallurgist, Wickwire Spencer Steel Corp.
Lancaster, Allwine & Rommel, Consultants on Patent Information

European Correspondents

Great Britain
A. C. Blackall
7 Vincent Sq. Mansions
London, S. W. 1, Eng.

Germany & Belgium
Paul Fidrmuc
Chapeaurougeweg 15
Hamburg, Ger.

R. E. Brown, Business Manager
Executive and Editorial Offices:
17 E. 42nd St., New York City. Telephone: Murray Hill 2-4188

Publication Office: Washington, N. J.
Annual Subscription, U. S. $5.00, Canada $5.60
50 Cents a Copy Issued Monthly Foreign, $7.50

Copyright, 1933

WIRELUBE
Wire Drawing Soaps

Do not gum up.
Do not clog dies.

Prevent carrier slipping when drawing non-ferrous wire.

Established 1869
B. F. Drakenfeld & Co.
INCORPORATED
45 Park Place
New York City

INFORMATION SERVICE

Improvements in processes and methods of production for rod, wire, strip and insulated wire and cable are being constantly made.

Manufacturers of materials, tools and equipment also are making additions and improvements to their lines.

Technical processes of production are being developed consistently.

To members of the Wire Association an information service is available by which they can obtain data on any subject relating to the industry on which they desire information.

WHY DON'T YOU JOIN THE WIRE ASSOCIATION?

ADDRESS THE SECRETARY,
Richard E. Brown, 17 E. 42nd St.,
New York, N. Y.

WIRE & WIRE PRODUCTS, Vol. 8, No. 7, July, 1933. Executive office, 17 East 42nd St., New York, N. Y. Published by the Quinn-Brown Publishing Corp., Richard E. Brown, President; R. S. Spengel, Secretary and Treasurer. Publication office, 49 E. Washington Ave., Washington, N. J. Subscription price: U. S., $5.00; Canada, $5.60 per year, 50 cents per copy; Foreign, $7.50 per year. Entered as second class mail at the Post Office, Washington, N. J., under Act of March, 1879. Copyright, 1933, by Quinn-Brown Publishing Corp.

Sleeper & Hartley TRADEMARK

Sleeper & Hartley TRADEMARK

AGAIN—
PRODUCTION

FOR several months we have placed before the Wire Industry on this page descriptive matter dealing with the high-speed, high-production Spoolers designed and manufactured by this company.

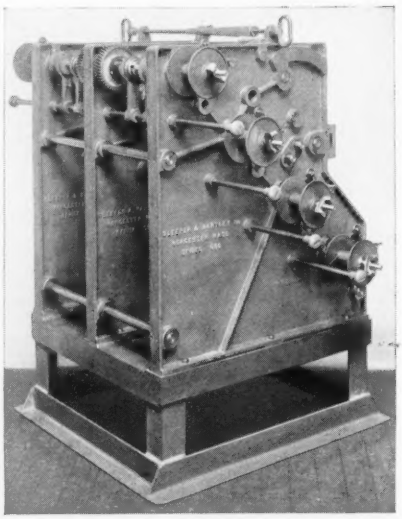
In the interests of a complete record of these machines, which range from the single spool, 2000-turns-per-minute type to the multi-spool machines, we present the latest addition to this line. It was delivered last month and is now operating 24 hours daily.

This is an Eight Spindle Spooler, another high-production machine but in no sense specialized.

It takes any spool up to 7x5 and handles wire from No. 29 (.015″) to No. 19 (.041″). It is a one-man machine, each spindle being individually controlled with a high-grade, easily adjusted clutch. Each spool has a positive stop to prevent over-running or unwinding.

This machine is compact, requiring small floor space and the power requirement is extremely low, being under 3 H. P.

Adjustability is built-in, the traverse, clutch and other adjustments being readily and easily made. The machine is simple to operate and maintenance costs have been reduced to a new low.



As remarked, this is not a specialized machine and it will earn its keep whether the order to be spooled is a few hundred pounds of wire or as many hundred tons. We recommend it to your investigation. The price is right.

SLEEPER & HARTLEY, INC.

WORCESTER, MASS., U. S. A.

DESIGNERS & BUILDERS OF HIGH PRODUCTION WIRE MACHINERY

WIRE & WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 8 JULY, 1933 No. 7

The Wire Drawing Die

By Kenneth B. Lewis
Consulting Wire Mill Engineer, Worcester, Mass.

PART I

A study of die stresses and strains during the drawing operation. Many of the ideas presented here are new and it is quite probable that some of the theories outlined will cause considerable discussion in the industry. The author invites such discussion in an effort to clarify the available data relating to die stresses.--The Editor

THERE is a striking resemblance between the drawing of wire and the breaking of a specimen in a tensile testing machine. The likeness is only superficial but it is strong enough to do a lot of mischief by eventually leading the inquiring mind into a position from which there is no logical escape. The event seems in both cases to proceed directly from a straight tensile strain. The yield point is clearly exceeded in both cases, crystal grains are elongated, the metal "work-hardens", the terms "elongation" and "reduction of area" are common to both phenomena. The conclusion leaps to the mind that wire drawing is a clear case of exceeding the yield point in tension, a special case perhaps, but closely akin to tensile testing. It is recognized that wire lightly drafted must flow at a stress much below the yield point in tension of the product, but there is a rather vague feeling that since the deformation is strictly local, the stresses have momentarily a higher unit value. The layman usually follows the matter no further, nor, as a rule, does the wire man.

IT is unfortunate that a tensile pull on the drawn wire is the most convenient way to bring into play the stresses which draw wire. In fact the word "draw" is confusing. Wire drawing is only one form of extrusion. The fact that a pull on the finished wire is not the only way to "draw" it, is well known to those operators of chain benches who use the push-pointer. Wire pushed through a die from behind is subjected to the same reactions in the die, takes practically the same power, and appears to have the same physical properties. This raises a suspicion that the die stresses are worth considering by themselves without reference to the accidental fact that they are customarily set up as the result of a pull on the finished wire.

WIRE drawing is, in fact a special application of a well known mechanical principle, that of the wedge, and the stresses in the die have in them no secrets that do not yield to the simplest forms of charting and calculation. Picture to yourself two cubic blocks of steel, one on top of the other, with a crack between them into which the thin edge of a steel wedge can be driven. Though the upper block weighs several tons, a few blows from a sledge on the butt of the wedge will drive it in and lift the block. The amount of force necessary to work the wedge in depends on the weight of the block, the friction, and the "pitch" of the wedge. Hammer blows are not essential, the wedge can be pushed in by a steady force. It is even conceivable that a long, easy tapered wedge, after being pushed in until its thin edge has come out on the far side, could be pulled through, instead of pushed.

✦ ✦ ✦

NOW imagine that the upper block is absolutely immovable and the wedge is of soft copper. The two blocks are perhaps an

eighth of an inch apart, and the greatest thickness of the wedge is a quarter of an inch. The wedge comes through all right, whether struck, pushed, or pulled, but instead of lifting the block it has itself been crushed down to one eighth inch thickness. If you pulled this wedge through the crack and found it deformed in this way you would blame not the force which pulled it through, but the hundred ton block, whose resistance was so great as to reverse the usual reactions. That is wire drawing. The die surrounds the wire on all sides instead of only top and bottom, and as the metal cannot escape sideways it must bulge forward or backward, but the die is the exact analogue of the immovable block, and the wire is the wedge which is too weak to do its job but which keeps on trying until it is crushed.

✦ ✦ ✦

THE wedge, the screw, the lever, and all related devices through whose use man has learned to multiply the value of his feeble muscles so as to control great natural forces, have been known since men first came down out of trees, and we learned long centuries ago how to calculate their value. They all depend on the principle of applying a small force through a great distance in order to induce a much greater force operating through a smaller distance, and often in a different direction. Building on experience, we have set up a division of mechanical study called graphics and have worked out the rules for calculating and charting the intensity and direction of those forces which are induced by other forces. The stress which results in the drawing of wire is clearly one of these induced forces, and there appears no reason why we should not chart it, trace it back to its origin, and possibly divide it so as to distinguish between the useful work and the friction.

✦ ✦ ✦

THIS matter of friction in the die is the great difficulty in analyzing die stresses. We must know something about it in order to lay out the graph, and yet the prime purpose of the graph is to learn something about friction. The only thing to do is to start with an assumption and see where it leads us. Mr. E. A. Atkins, in a paper presented before a group of scientists in England several years ago made the statement that a number 5 rod in its first draft to .160 requires a pull of 1500 lbs. of which 31% is used up in overcoming die friction. No proofs were submitted and we are not bound to believe the statement true, but let us lay it out and see if anything logical and useful comes forth.

✦ ✦ ✦

IN order to lay the groundwork and agree on some terms I will show in figure 1 a wire passing through a die. The die will be considered as perfectly conical, all

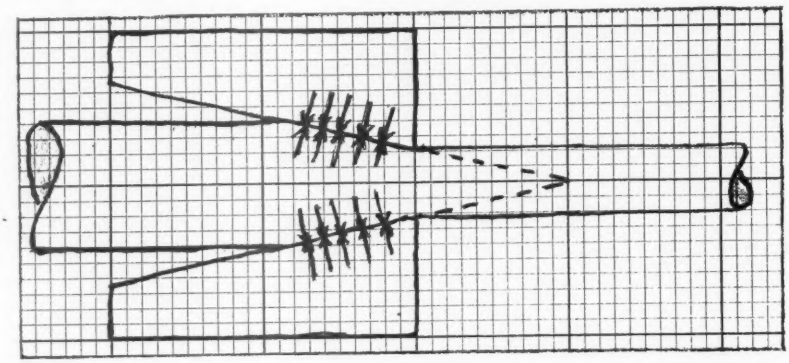


Figure 1.

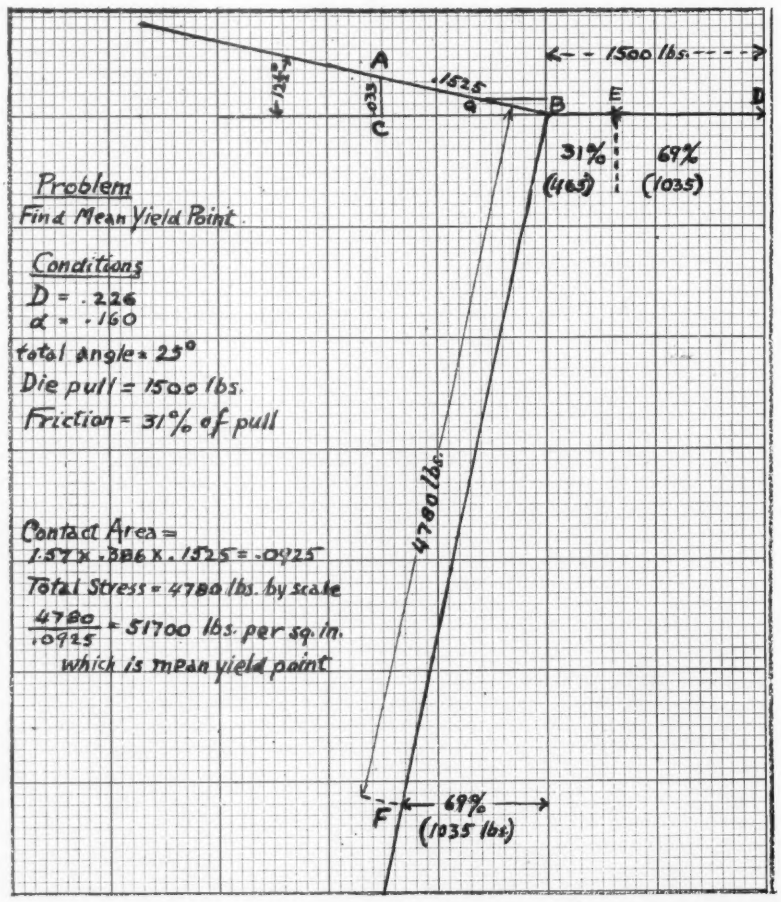


Figure 2.

taper and no straight bearing. This simplifies the early calculations, and we can consider later the influence of bearing length. That part of the wire which is in contact with the die has the shape of a cone with its end cut off square. This figure is familiar to students of geometry as a "frustrum of a cone". The angle at the peak of this cone, as shown in dotted lines is the die angle. All graph work and figuring however is simpler if half of this angle is used. I will use the terms "half-angle" and "total angle".

✦ ✦ ✦

THE wire and the die are pressing against each other in a direction at right angle to their line of contact, as shown by the small arrows. According to mechanical laws, each of these little diagonal forces has "components" in other directions, including a vertical component and a horizontal component. We don't care about the vertical, for its effect is in the direction of splitting the die, and we know the die is not going to split. The horizontal component however is vitally interesting for it is in the direction of the die pull. Now let us lay out Mr. Atkins' case, and call it figure 2.

✦ ✦ ✦

LET us take a good heavy pull, say from a .226 rod (nominal No. 5) to a .160 wire. This is a 50% reduction of area and we know it can be done when everything is favorable. We know that a total angle of about 25 degrees will be big enough. As we are going to lay out the job in skeleton form, using only the upper half of the die, we lay out a "half-angle" of 12½ degrees, and mark it ABC. Now we must search for the value of the unit stress that will be needed to crush this steel in the cone. By unit stress I mean a stress expressed as pounds per square inch. We must first agree on the number of square inches involved. As the wire and die are working on each other in the area of the cone frustrum it seems logical to take this area as our square inch measure. Its value must now be settled. There is a formula for the area of

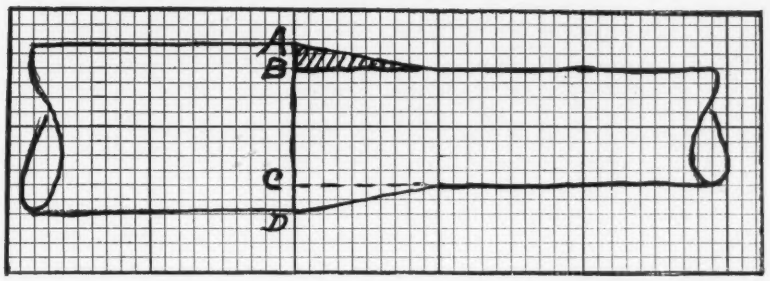


Figure 3.

✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

the frustrum of a cone. It is 1.57 x (D+d) x S, in which D and d are the diameters of the two bases and S is the length of the "slant side." We have the two diameters, for they are our starting and finishing sizes of wire. We must get the slant side by scaling it.

✦ ✦ ✦

IN figure 3 I have diagrammed the draft to show the relations between the real job and the skeleton we are using in fig. 2. Here you see the wire in the cone, and the shaded part represents the space we are using in figure 2.

✦ ✦ ✦

ROD diameter (A to D) is .226 and wire diameter (B to C) is .160. Subtract one from the other and we get .066, which is AB plus CD and it is clear then that AB is half of .066, or .033. Now we can lay out in figure 2 a right triangle whose base is .033 to scale, whose sides meet at 12½ degrees, and we can scale the slant side. I do this, taking each little square as .01, and the slant side scales .1525 inches.

✦ ✦ ✦

NOW we can figure the contact area, 1.57 x (D+d) x S, or 1.57 x .386 x .1525 and the product is .0925, which is the area of contact between die and wire.

✦ ✦ ✦

NOW let us scale some stresses in pounds. From point B, the exit of the die, we lay out a line BD, in the direction of the drawing strain. It represents, according to Mr. Atkins, 1500 lbs., and if we give it 2 big squares, each big square will be 750 lbs., each small square 75 lbs. As Mr. Atkins has declared that 31% of this pull is friction let us mark off 31% from the left and mark the point E. According to Mr. Atkins then we have 465 lbs. die friction, effective in the direction of pull, and the horizontal component of the stress that deforms the metal is 1500-465, or 1035 lbs.

✦ ✦ ✦

WE must find some simple way to chart the forces acting between the wire and the die. According to graphics we can represent them as lying along a line drawn from the point B at right angles to the die wall AB, so we will draw the line. We don't know how long to make this line, whose length, when determined, will scale so as to indicate the total pounds stress in the cone, but we do know that its horizontal component is 1035 lbs. Take this line ED, which is 1035 lbs. to scale, and follow down the stress diagonal until there is just room between the diagonal and the vertical line dropping from point B, to get in the line ED, horizontally. Now since ED is the horizontal component of the forces represented by the diagonal, we are entirely warranted in saying that the diagonal, down to the point F, is the force itself, accurately to scale. Scale it off, at 750 pounds per square, and you find it to be 4780 pounds. By construction this is the total force operative in the die cone.

✦ ✦ ✦

THE next step is to translate the total force into pounds per sq. inch. The area of pressure we calculated at .0925 square inches. Divide 4780 lbs. by .0925 and we find that the unit stress required to deform this basic steel is 51,700 lbs. per square inch. The thing

that comes to mind at once is that this is just about the tensile strength of soft basic rod. We have no right to say that steel wire must be stressed up to the breaking point before it will flow. Remember, however, that in the attempt to settle the stress at which it will flow we are shooting at a moving target. Our wire as it first feels the pinch of the die has a tensile of about 50,000 lbs. per square inch but before it comes out of the die throat its tensile strength and yield point have gone up to about 90,000 lbs. What we are trying to measure is the average, or as it may be called, mean yield point. I will show later that the initial tensile is a pretty fair measure. Meanwhile we must admit that in default of a known basis the tensile strength is as good as any.

Mr. Atkins has said that 31%, or 465 lbs. is frictional drag in the die. We should be able to pin this down to something definite. First, we must recognize that this 465 lbs. is not actual friction in the die, but its horizontal component. The frictional force as actually developed will lie along the slant side. If we take the friction line EB and lay it across the corner, as shown, GB will be the actual friction. At this small angle it barely exceeds its own horizontal component, scaling about 470. The friction between these surfaces, die and wire, varies directly with the total pressure, and as the pressure has been determined at 4780 and the actual friction is 470, the relation between them is about 10 to 1. This fixes the "coefficient of friction" at 10 per cent or .10. Coefficient of friction, in case you have forgotten the term, is the relation between the total pressure between two surfaces and the force needed to slide one on the other. In other words, if a 100 lb. block of ice is lying on the floor, and it takes 10 lbs. pull to slide it along, its coefficient of friction with respect to the floor is .10. This coefficient of friction is a mighty important matter in the wire mill, as upon it depends the amount that wire can be drafted. It is the only measure of the effectiveness of various systems of lubrication, and I will say now that the chief purpose of this study of die stresses is to find a way to get it into definite figures.

✦ ✦ ✦

ON the whole, this little exercise in graphics has come out pretty well and if Mr. Atkins was guessing he was guessing pretty shrewdly. We know that 1500 lbs. is about right for the die pull, being just a little below the breaking strain of .160 basic. Figuring back we got 51,700 for a mean yield stress, which is about the figure we would expect. The coefficient of friction has come out .10, and anyone who has dealt much with such matters as coefficient of friction between metals at high pressures with smooth surfaces and scanty lubrication will recognize that as a reasonable figure. The best thing is that we seem to have in this graphic method a handy tool to work with, and something good may come of its use. For the sake of practice let us work out another example.

✦ ✦ ✦

IN fig. 4 I have started with what I think would be the breaking load of the .160 wire, namely 1680 lbs., and tried to see whether I could with this amount of pull draw the same heavy draft in a die of smaller angle. Laying out a half-angle of 9 degrees, (total die angle 18 degrees) I find the slant side scales .2113 inches and the contact area figures to .128 square inches. In dividing the die pull of 1680 lbs. I assume that the force needed to deform the metal, from and to the same size as before, will be the same as before. That leaves 645 lbs. for friction in

(*Please turn to page 219*)

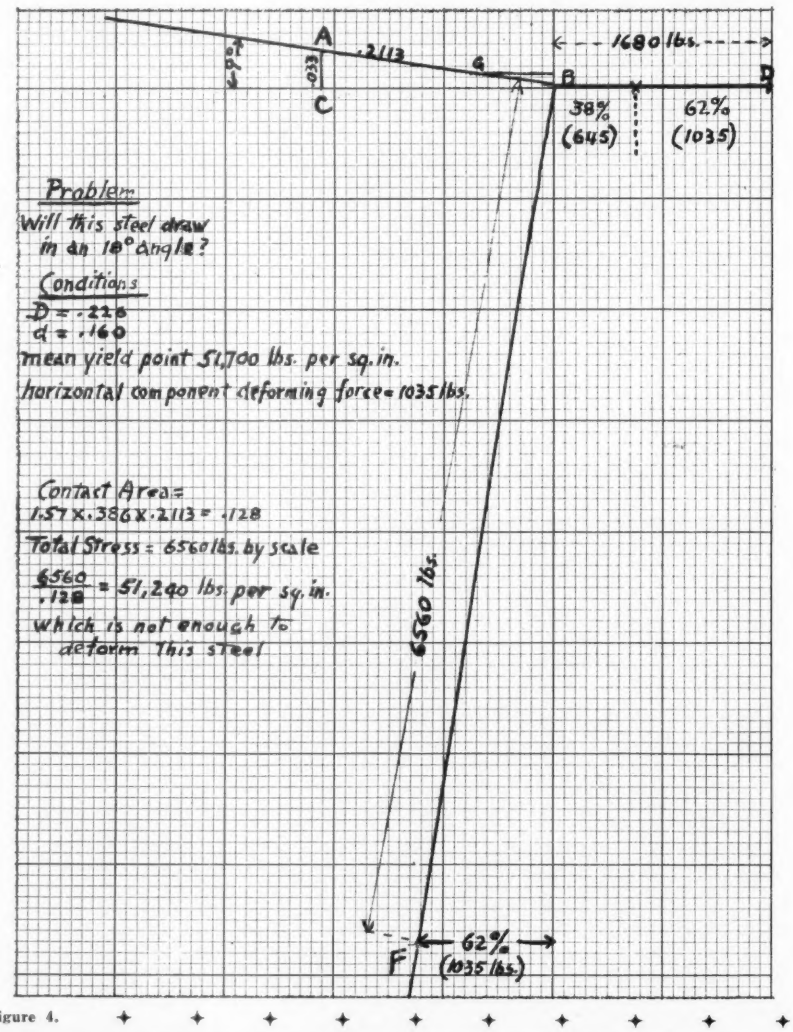


Figure 4.

Stresses In Helical Springs

By R. F. Vogt

Assistant Consulting Engineer, Allis-Chalmers Co.,
Milwaukee, Wisc.

The paper suggests new formulas for calculating dimensions and stresses of helical springs, taking proper recognition of the influence of the curvature of the wire or bar and also of the accompanying bending and shearing stresses due to the regular load. The new formulas express the values of the combined stresses in tensile strength. A slight correction of the conventional equation for spring deflection is explained, this correction taking into account the effect of curvature of the spring bar on spring deflection. Curves showing tensile stresses and dimensions, and curves showing the deflections of helical extension and compression springs are included with the paper.

THE conventional spring stress formula does not consider the influence of the curvature of the

$$T = \frac{5 \cdot P \cdot D}{\pi \cdot d^3}$$

D = mean diameter of coil
d = diameter of bar
T = torsional or shearing stress
π = 3.1416
P = load

bar and neglects the bending and direct shearing action of the load. It gives a T of about 40% less than the actual value for a ratio of $\frac{D}{d} = 4$

✦ ✦ ✦

AS early as 1913, Dr. Ing. A. Röver showed in his article in VDI, No. 57, November 29, that the actual maximum stress in a helical spring is considerably higher than indicated by the old formula. Since then a number of others, among them, A. M. Wahl, I. J. Wood, E. Honegger, Rothhaus and O. Göhner, have published papers on the same subject.

✦ ✦ ✦

OF special interest are the equations for stresses in helical springs given by A. M. Wahl, A. Röver and O. Göhner. The equations by O. Göhner (see VDI, March 12, 1932) are very accurate but also very complicated in their unreduced forms. By allowing errors of less than 1% Göhner simplifies his equation for torsional stress to a form which is identical to the equation of Röver, and results in values of less than 1% above the accurate amount for spring indices of 4. For larger indices the error diminishes quickly to zero at the spring index of 10 being very little below the accurate value at indices above 10. Very similar to these equations is the one from A. M. Wahl, who, however, does not take the pitch angle of the helix into consideration. With the pitch angle $\alpha = 0$, Röver's equation gives results which are a little less than 1% below those of A. M. Wahl's equation.

✦ ✦ ✦

ALL these equations for stresses in helical springs are comparatively cumbersome. The difficulties in determining the actual pitch angle of the helix, at which the torsional and the bending stresses are to be calculated and the complication of combining the two stresses into one, is, in many instances, sufficient reason to avoid the use of these equations.

✦ ✦ ✦

THE necessity of reliable equations of simpler form which include all factors influencing the stress in a helical spring is, therefore, apparent. In the following, simple equations for the stress in helical springs, one for tension and one for compression springs, are developed where an average accuracy within 1% to 2% is maintained. Only for large indices, combined with low tensile stress S—O, will the error of the equations be larger, but will be less than 10% for extreme cases of $\frac{D}{d} = 20$ with $S = O$. In commercially practical helical spring applications the error will be within 1% to 2%.

✦ ✦ ✦

THESE new equations are based on Röver's equations which were found to be sufficiently accurate to warrant further development. Röver's equations as given in Hütte, 26th edition, 1st volume, page 669, are as follows:

I $$T_{max} = \frac{3 \cdot P \cdot D}{\pi \cdot d^3} \left(\frac{1}{1 - \frac{d}{D} \cos^2 \alpha} + \frac{1 + \sin^2 \alpha}{4 \frac{D}{d}} \right) \cdot \cos \alpha$$

for maximum torsional stress

II $$B_{max} = \frac{16 \cdot P \cdot D}{\pi \cdot d^3} \left(\frac{1}{1 - \frac{d}{D} \cos^2 \alpha} + \frac{\sin^2 \alpha}{4 \frac{D}{d}} \right) \cdot \sin \alpha$$

for maximum bending stress

T_{max} = maximum torsional stress in bar cross section
D = mean coil diameter
d = bar diameter
P = load
α = coil pitch angle
π = 3.1416
B_{max} = maximum bending stress in bar
S_{max} = maximum fibre stress in spring material
S = tensile stress
m = extension/contraction

✦ ✦ ✦

THE maximum fibre stress in the spring is found by combining the torsional stress and the bending stress according to formula.

Contributed by the Special Research Committee on Mechanical Springs for presentation at the Mechanical Springs Session of the Semi-Annual Meeting of The American Society of Mechanical Engineers, Chicago, Ill., June 26-30, 1933.

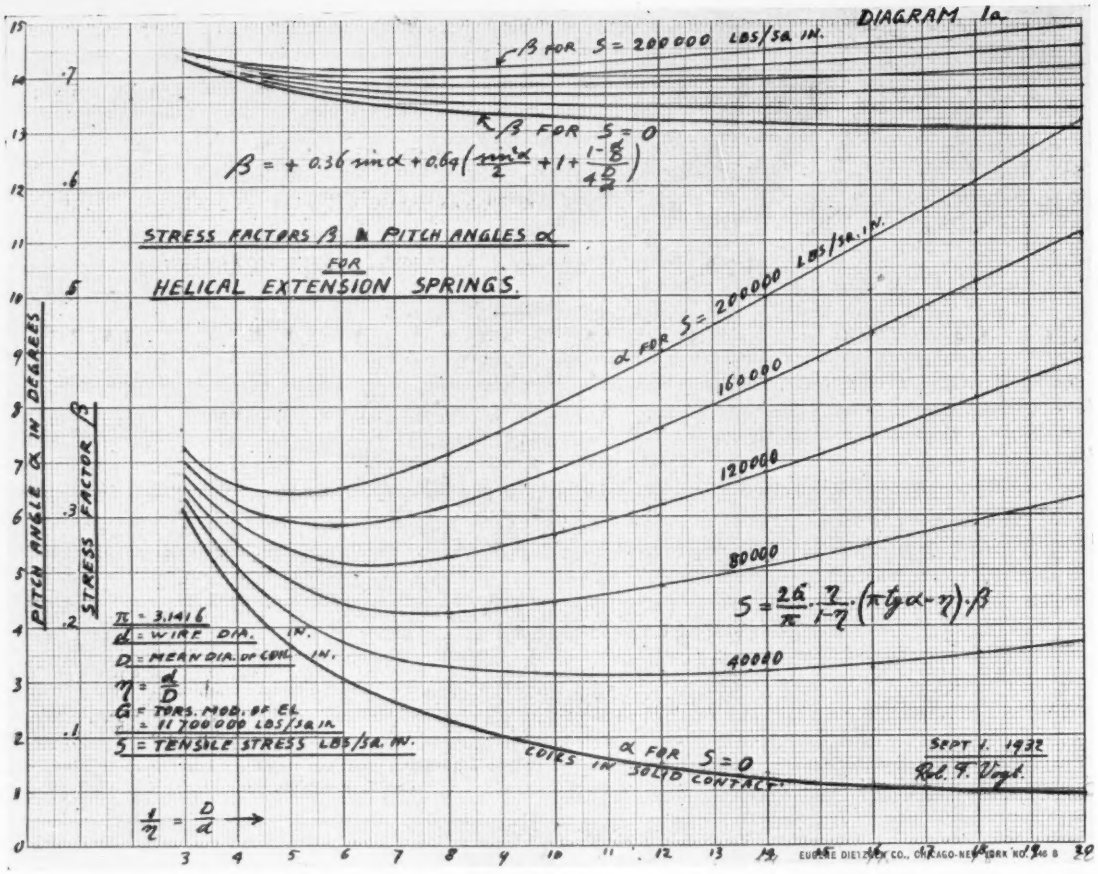


DIAGRAM 1a.
STRESS FACTORS β & PITCH ANGLES α
FOR
HELICAL EXTENSION SPRINGS.
β FOR S = 200000 LBS/SQ. IN.
β FOR S = 0
β = + 0.36 sin α + 0.64 (sin²α/2 + 1 + (1 - η)/(4 D/d))
α FOR S = 200000 LBS/SQ. IN.
160000
120000
80000
40000
α FOR S = 0
COILS IN SOLID CONTACT.
S = 2G/π · η/(1-η) · (π tg α - η) · β
π = 3.1416
d = WIRE DIA. IN.
D = MEAN DIA. OF COIL IN.
η = d/D
G = TORS. MOD. OF EL. = 11700000 LBS/SQ. IN.
S = TENSILE STRESS LBS/SQ. IN.
1/η = D/d →
PITCH ANGLE α IN DEGREES
STRESS FACTOR β
SEPT. 1. 1932
Rob. T. Vogt.
EUGENE DIETZGEN CO., CHICAGO-NEW YORK No. 240 B

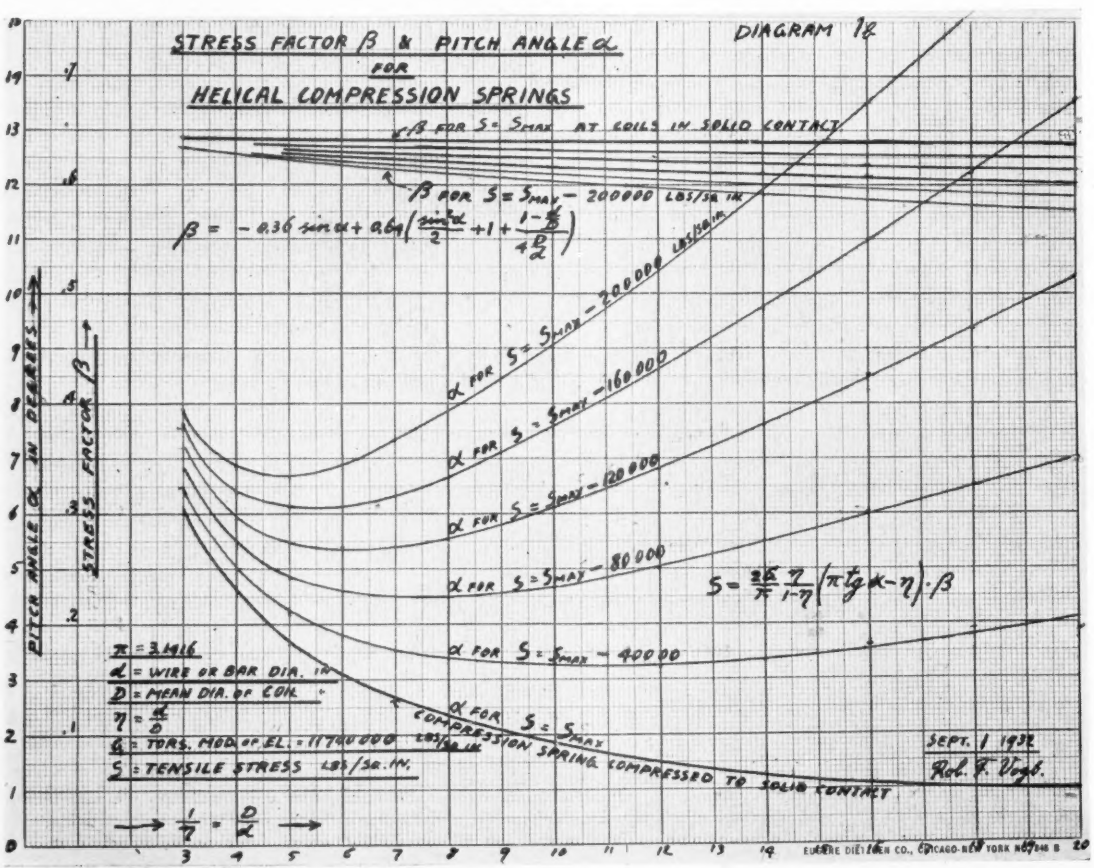


DIAGRAM 1a
STRESS FACTOR β & PITCH ANGLE α
FOR
HELICAL COMPRESSION SPRINGS
β FOR S = S_MAX AT COILS IN SOLID CONTACT.
β FOR S = S_MAX - 200000 LBS/SQ. IN.
β = - 0.36 sin α + 0.64 (sin²α/2 + 1 + (1 - η)/(4 D/d))
α FOR S = S_MAX - 200000 LBS/SQ. IN.
α FOR S = S_MAX - 160000
α FOR S = S_MAX - 120000
α FOR S = S_MAX - 80000
α FOR S = S_MAX - 40000
α FOR S = S_MAX
COMPRESSION SPRING COMPRESSED TO SOLID CONTACT
S = 2G/π · η/(1-η) · (π tg α - η) · β
π = 3.1416
d = WIRE OR BAR DIA. IN.
D = MEAN DIA. OF COIL
η = d/D
G = TORS. MOD. OF EL. = 11700000 LBS/SQ. IN.
S = TENSILE STRESS LBS/SQ. IN.
→ 1/η = D/d →
PITCH ANGLE α IN DEGREES →
STRESS FACTOR β →
SEPT. 1 1932
Rob. T. Vogt.
EUGENE DIETZGEN CO., CHICAGO-NEW YORK No. 240 B

III $$S' = +\frac{1-\frac{1}{m}}{2}B + \frac{1+\frac{1}{m}}{2}\cdot\sqrt{B^2+4T^2} \quad \text{for extension springs}$$

$$S'' = -\frac{1-\frac{1}{m}}{2}B + \frac{1+\frac{1}{m}}{2}\cdot\sqrt{B^2+4T^2} \quad \text{for compression springs}$$

✦ ✦ ✦

DR. Ing. Zacharias assumes m = 4, the conventional value for steel is taken as m = 10/3 and the Huette gives for spring steel m = 3.63. Assuming the latter as the nearest to correct value, we find:

IIIa $$S = \pm\ 0.36B + 0.64\sqrt{B^2+4T^2}$$

✦ ✦ ✦

ALTHOUGH this formula is simple enough, the actual calculation of the fibre stress is quite cumbersome. By means of eliminating negligible quantities from the above values of torsional, bending and combined stresses, the writer developed a very simple formula for the combined stress in helical springs as follows:

✦ ✦ ✦

THE pitch angle being usually less than 10° makes it permissible to assume

$\frac{\sin^2\alpha}{4\,\frac{D}{d}} = 0$ and $\cos\alpha = 1$, and we find:

$$S = \pm\ 0.36\,\frac{16\cdot P\cdot D\cdot\sin\alpha}{\pi\cdot d^3(1-\frac{d}{D})} + 0.64\sqrt{\left(\frac{16\cdot P\cdot D\,\sin\alpha}{\pi\,d^3(1-\frac{d}{D})}\right)^2 + 4\left[\frac{8\cdot P\cdot D}{\pi\,d^3}\left(\frac{1}{1-\frac{d}{D}}+\frac{1}{4\,\frac{D}{d}}\right)\right]^2}$$

$$= \pm\ 0.36\,\frac{16\cdot P\cdot D\,\sin\alpha}{\pi\cdot d^3(1-\frac{d}{D})} + 0.64\,\frac{16\cdot P\cdot D}{\pi\cdot d^3}\sqrt{\frac{\sin^2\alpha}{(1-\frac{d}{D})^2}+\left(\frac{1}{1-\frac{d}{D}}+\frac{1}{4\,\frac{D}{d}}\right)^2}$$

$$= \frac{16\cdot P\cdot D}{\pi\cdot d^3(1-\frac{d}{D})}\left(\pm\ 0.36\,\sin\alpha + 0.64\sqrt{\sin^2\alpha+\left(1+\frac{1-\frac{d}{D}}{4\,\frac{D}{d}}\right)^2}\right)$$

IV $$S = \frac{16\cdot P\cdot D}{\pi\cdot d^3(1-\frac{d}{D})}\left[\pm\ 0.36\,\sin\alpha + 0.64\left(\frac{\sin^2\alpha}{2}+1+\frac{1-\frac{d}{D}}{4\,\frac{D}{d}}\right)\right]$$

$$S = \frac{16\cdot P\cdot D}{\pi\cdot d^3(1-\frac{d}{D})}\cdot\beta \qquad \beta = \pm\ 0.36\,\sin\alpha + 0.64\left(\frac{\sin^2\alpha}{2}+1+\frac{1-\frac{d}{D}}{4\,\frac{D}{d}}\right)$$

✦ ✦ ✦

ASSUMING helical extension springs wound closely without initial tension and compression springs that may be compressed to solid contact without straining the material beyond the elastic limit, the values

$$\beta = \pm\ 0.36\,\sin\alpha + 0.64\left(\frac{\sin^2\alpha}{2}+1+\frac{1-\frac{d}{D}}{4\,\frac{D}{d}}\right)$$

for various ratios $\frac{D}{d}$ and various pitch angles were determined and are shown in curves β of diagram Ia for extension springs and Ib for compression springs. Curve α gives the pitch angles at various stresses and for various ratios. $\frac{D}{d}$.

✦ ✦ ✦

FOR compression springs the maximum tension S is at pitch angles represented by curve α for S, and the zero tension is at pitch angles represented by curve α for S — S.

The values β as shown by the curves do not change much for various $\frac{D}{d}$ and various load.

✦ ✦ ✦

FOR extension springs β = .666 to .710 for $\frac{D}{d}$ 4 to 10 and 0 to 200,000 lbs./sq. in. stress. The total change is about 6%. Considering that we should not stress the springs over, say, 140,000 lbs./sq. in. and that we do not often use compression springs loaded to solid contact, the total change in β is hardly more than 3% for springs in commercial use. This fact suggests that we choose a fixed value for β, say β = .707 so that $\frac{16\beta}{\pi} = 3.6$. But since the error in using this value will seldom be as much as 3% (and this on the safe side) and, in most cases, less than 1% (also on the safe side), β = .707 is the logical fixed value to choose for the purpose of simplifying the stress formula IV for extension springs.

Therefore $$S' = \frac{16\cdot P\cdot D}{\pi\cdot d^3\cdot(1-\frac{d}{D})}\cdot .707$$

V $$S' = \frac{3.6\cdot P\cdot D}{d^3\cdot(1-\frac{d}{D})}$$ combined with the deflection formula

Va $$S' = \frac{.45\cdot G\cdot f\cdot\eta^2}{n\cdot d\cdot(1-\eta)} \qquad \eta = d/D$$

✦ ✦ ✦

FOR compression springs compressed to solid contact the value for β is almost constant for springs of any ratio $\frac{D}{d}$ between $\frac{D}{d} = 3$ and $\frac{D}{d} = 20$, varying only between β = .6433 to .6404. For compression spring loads of less amount than required to compress the spring to solid contact the factor β is smaller. For zero load on a compression spring of 200,000 lbs./sq. in. stress when compressed solid and a ratio of $\frac{D}{d} = 10$ the factor β = .605. However, we are mostly interested in the stress at maximum load, i.e., the load when the spring is compressed to solid contact for which condition β = .642, so that formula IV for compression springs may be written as:

V"a $$S'' = \frac{16\cdot .642}{\pi}\cdot\frac{P\cdot D}{d^3\cdot(1-\frac{d}{D})} = \frac{3.28\,P\cdot D}{d^3\cdot(1-\frac{d}{D})}$$

V"b $$S'' = \frac{.41\cdot G\cdot f\cdot\eta^2}{n\cdot d\cdot(1-\eta)} \qquad \eta = d/D$$

✦ ✦ ✦

FOR helical springs with pitch angles larger than 15° when stressed (which are scarce) formula IV should be used for determining the tensile stress.

✦ ✦ ✦

WE find a striking similarity between the conventional torsional stress formula $T = \frac{8.P.D}{\pi\,d^3}$ and

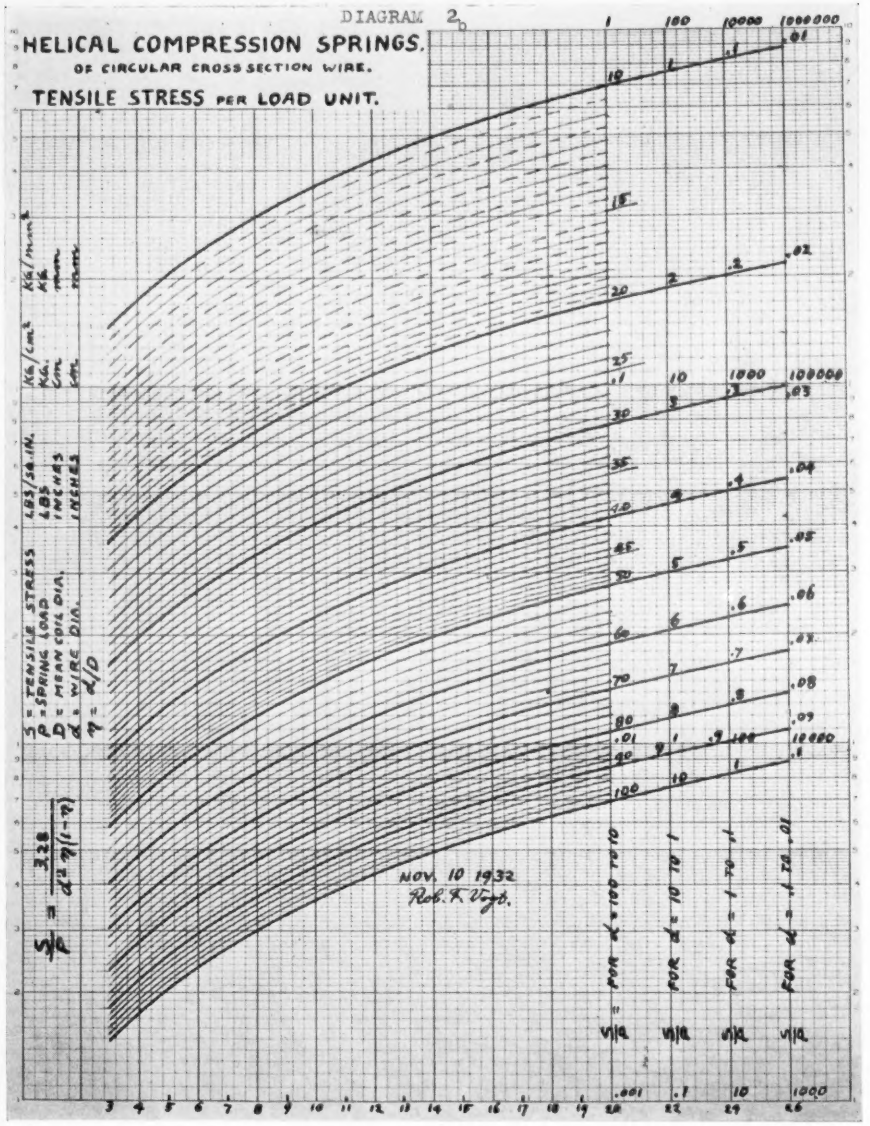


DIAGRAM 2b
HELICAL COMPRESSION SPRINGS.
OF CIRCULAR CROSS SECTION WIRE.
TENSILE STRESS PER LOAD UNIT.
S = TENSILE STRESS
P = SPRING LOAD
D = MEAN COIL DIA.
d = WIRE DIA.
η = d/D
S/P = 3.28 / d³ η(1-η)
NOV. 10 1932
Robt. F. Vogt.
FOR d = 100 TO 10
FOR d = 10 TO 1
FOR d = 1 TO .1
FOR d = .1 TO .01
S/P

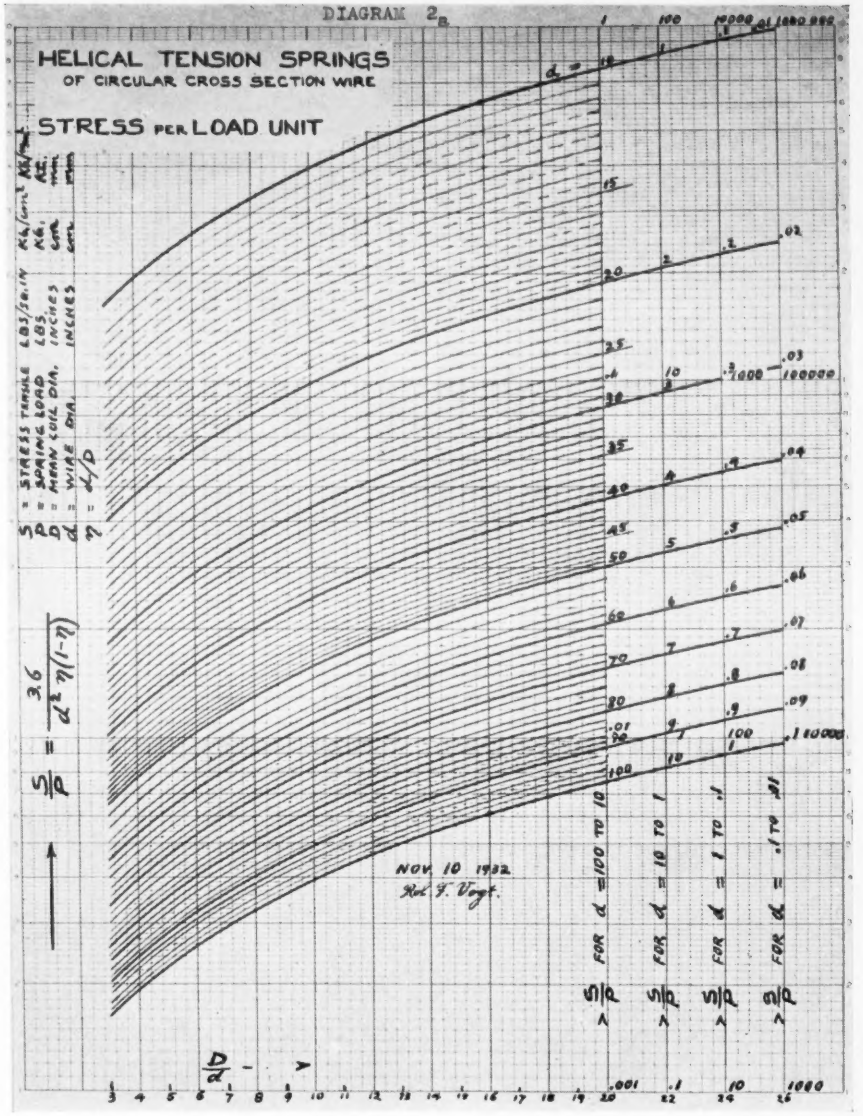


DIAGRAM 2B
HELICAL TENSION SPRINGS
OF CIRCULAR CROSS SECTION WIRE
STRESS PER LOAD UNIT
S = STRESS TENSILE
P = SPRING LOAD
D = MEAN COIL DIA.
d = WIRE DIA.
η = d/D
S/P = 3.6 / d³ η(1-η)
NOV. 10 1932
Robt. F. Vogt.
FOR d = 100 TO 10
FOR d = 10 TO 1
FOR d = 1 TO .1
FOR d = .1 TO .01
S/P
D/d

this new formula for tensile stress in a helical spring

$$S' = \frac{16 \cdot .707}{\pi} \cdot \frac{P \cdot D}{d^3 \cdot (1 - \frac{d}{D})} = \frac{11.27 \cdot P \cdot D}{\pi \cdot d^3 \cdot (1 - \frac{d}{D})} \quad \text{for extension springs}$$

$$S'' = \frac{16 \cdot .642}{\pi} \cdot \frac{P \cdot D}{d^3 \cdot (1 - \frac{d}{D})} = \frac{10.25 \cdot P \cdot D}{\pi \cdot d^3 \cdot (1 - \frac{d}{D})} \quad \text{for compression springs}$$

✦ ✦ ✦

INDEED, if we transpose the torsional stress T into tensile stress S we have

$$S^t = 1.3T = 1.3 \frac{8 \cdot P \cdot D}{\pi \cdot d^3} = \frac{10.4 \cdot P \cdot D}{\pi \cdot d^3}$$

✦ ✦ ✦

THE main difference between the two values S & S′ is the factor $(1 - \frac{d}{D})$ in the denominator for

$S' (1 - \frac{d}{D})$ expresses the influence of curvature of the bar. The difference between the factor 10.4, and the factors 11.2 and 10.25, respectively, corresponds to the straight shear of the load P/2, plus the bending stress.

✦ ✦ ✦

TO illustrate the accuracy of the formula for

$$S'' = \frac{3.28 \cdot P \cdot D}{d^3 \cdot (1 - \frac{d}{D})}$$

compression springs we take as an example the ARA class D outer spring of 4¼″ mean diameter and 1 3/16″ bar diameter. This spring compresses to solid height under a load of 14250 lbs. If we calculate according to Röver's formulas for T_{max} and B_{max} and combine the two stresses to S_1 we find:

T = 133292 lbs./sq. in.
B = 22580 lbs./sq. in.
S_1 = 163551 lbs./sq. in.

and calculated from formula Va the stress equals

$$S'' = \frac{3.28 \cdot P \cdot D}{d^3 \cdot (1 - \frac{d}{D})} = 164623 \text{ lbs/sq.in.}$$

S'' = .65% over S_1 for this particular spring.

✦ ✦ ✦

INASMUCH as we cannot predict the strength of the material within such close limits the formulas given are fully satisfactory.

✦ ✦ ✦

BESIDES the advantage of being able to calculate the combined bending and shearing stresses with this one formula, we can judge the strength of the spring in terms of tensile rather than torsional stress, which is of great importance, as we are more familiar with tensile stress than with torsional or shearing stresses. The ultimate tensile stress is easily determined for all materials by test and can be specified directly as such or in terms of Brinell hardness, which for steel is about $\frac{\text{Ultimate Stress}}{500}$

Using formula $S' = \frac{3.6 \cdot P \cdot D}{d^3 \cdot (1 - \frac{d}{D})}$ or $S'' = \frac{3.28 \cdot P \cdot D}{d^3 \cdot (1 - \frac{d}{D})}$

as a basis, the curves on diagrams 2a and 2b for maximum tensile stresses for extension and compression springs, respectively, were plotted on logarithmic paper. These curves are very convenient for selecting the proper size of helical springs for any given load at any desired maximum stress.

✦ ✦ ✦

DIAGRAMS 3a and 3b, respectively, give the deflection of helical extension and compression springs per inch wire or bar diameter, and per coil for various tensile stresses. Knowing the wire and coil diameter and maximum tensile stress desired the deflection per coil may be found by multiplying the value $\frac{f}{d.n}$ for the given $\frac{D}{d}$ and stress by d.

✦ ✦ ✦

THE main advantage of these curves for spring stresses and deflection is the fact that they indicate at a glance the full range of spring data from which it is possible to choose the most desirable specification for any given spring problem without repeating any spring calculations.

✦ ✦ ✦

THE deflection equation given on sheet 3a is derived from the conventional deflection equation

$$\frac{f}{d \cdot n} = \frac{8}{3.283} \cdot \left[8 \cdot \frac{1-\eta}{\eta^2} + 2.4 \cdot (1-\eta) \right]$$

$f' = \frac{8.n.D^3.P}{G.d^4}$ in which a correction is added for the deflection due to pure shearing stresses in the spring wire. By substituting for the spring load P its equivalent value expressed in tensile stress, the above equation is formed as shown in the following paragraphs:

✦ ✦ ✦

THE conventional equation for helical spring deflection $f' = \frac{8.n.D^3.P}{G.d^4}$, although accurate enough for all practical purposes, is theoretically inaccurate due to neglecting the effect of the curvature of the bar, and also due to the omission of the additional deflection caused by direct shear in the spring wire or bar. The deflection due to direct shear in most deflection problems is usually so small that it may be omitted without any practical consequences. It is especially so where the length of the beam is comparatively small in reference to the cross section of the beam. Accurate spring deflection tests, like those made by A. M. Wahl, have indicated that helical springs with smaller indices show deflections which do not entirely conform with the expected results based on conventional spring deflection formulas. The writer's investigations show that this diversion from the conventional spring equation is due to the omission of the deflection caused by pure shear in the spring bar.

✦ ✦ ✦

THE deflection of pure shear in a cantilever bar is $f'' = \gamma.L = \frac{T}{G} . L = \frac{P.L}{F_s.G}$. According to Hütte

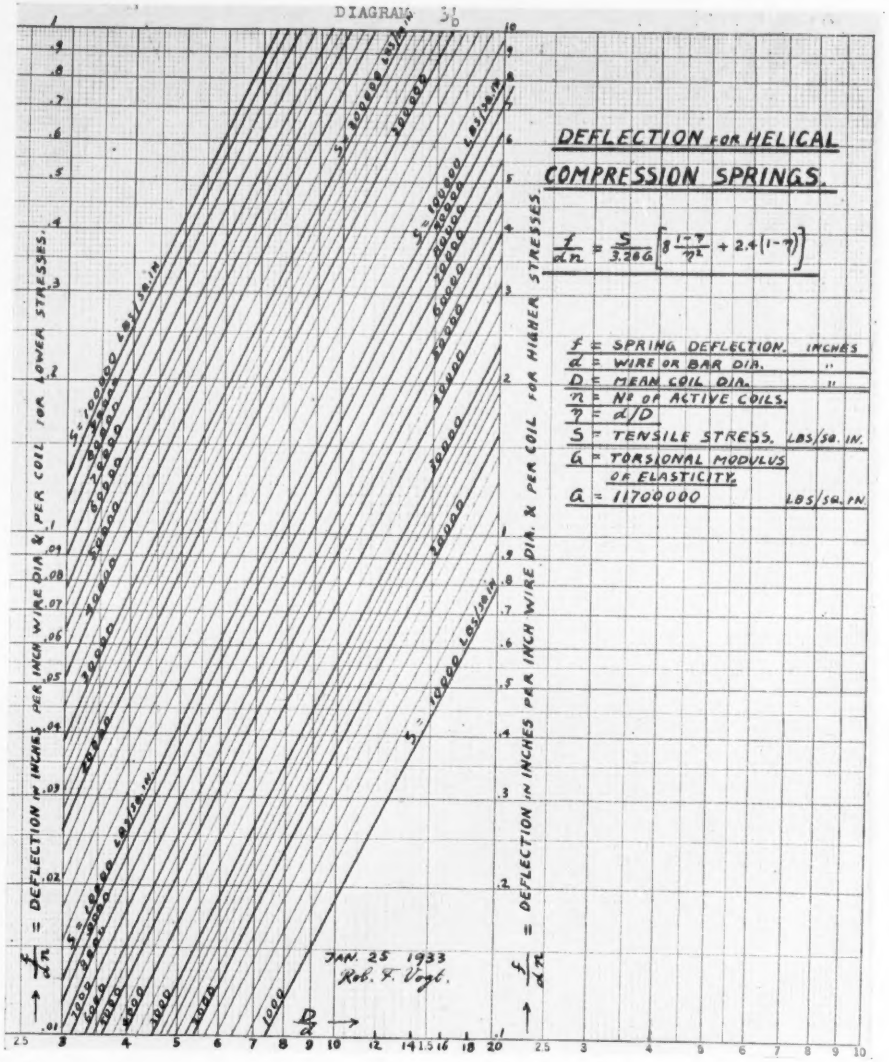


DIAGRAM 3b
DEFLECTION FOR HELICAL COMPRESSION SPRINGS.
$\frac{f}{dn} = \frac{S}{3.2G}\left[8\frac{1-\gamma}{\gamma^2} + 2.4(1-\gamma)\right]$
f = SPRING DEFLECTION. INCHES
d = WIRE OR BAR DIA. "
D = MEAN COIL DIA. "
n = No OF ACTIVE COILS.
γ = d/D
S = TENSILE STRESS. LBS/SQ. IN.
G = TORSIONAL MODULUS OF ELASTICITY.
G = 11700000 LBS/SQ. IN.
JAN. 25 1933
Rob. F. Vogt.
= DEFLECTION IN INCHES PER INCH WIRE DIA. & PER COIL FOR LOWER STRESSES.
= DEFLECTION IN INCHES PER INCH WIRE DIA. & PER COIL FOR HIGHER STRESSES.

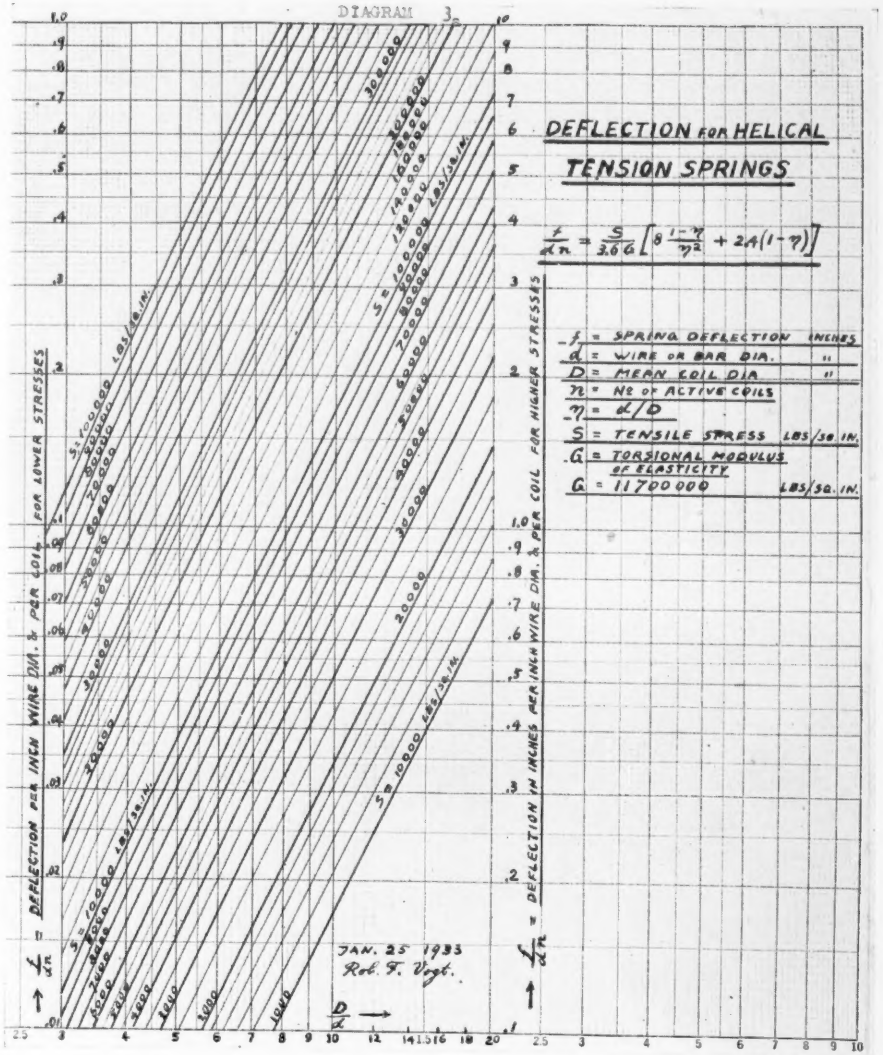


DIAGRAM 3a
DEFLECTION FOR HELICAL TENSION SPRINGS
$\frac{f}{dn} = \frac{S}{3.2G}\left[8\frac{1-\gamma}{\gamma^2} + 2.4(1-\gamma)\right]$
f = SPRING DEFLECTION INCHES
d = WIRE OR BAR DIA. "
D = MEAN COIL DIA "
n = No OF ACTIVE COILS
γ = d/D
S = TENSILE STRESS LBS/SQ IN.
G = TORSIONAL MODULUS OF ELASTICITY
G = 11700000 LBS/SQ. IN.
JAN. 25 1933
Rob. F. Vogt.
= DEFLECTION PER INCH WIRE DIA. & PER COIL FOR LOWER STRESSES
= DEFLECTION IN INCHES PER INCH WIRE DIA. & PER COIL FOR HIGHER STRESSES

the effective area for shear in a circular cross section is $F_s = \frac{F}{1.2} = \frac{d^2\,\pi}{4.1.2}$ so that the deflection f of this bar becomes $f'' = \frac{4.8.P.L}{G.d^2.\pi}$.

P = Load or force causing shear
γ = Shear angle in radians
L = Length of bar subjected to shear
G = Modulus of elasticity for shear
T = Shearing stress
F = Cross section area of bar = $d^2.\pi/4$
F_s = Effective area for shear

1907. In this development Röver shows that in a curved bar, loaded in the center of the curvature by force P, which acts vertical to the plane of the curvature, the sum of the components of the shear forces which are parallel to the force P is equal to P/2 and acts in the opposite direction of force P. This sum of unbalanced shear stress components, equal to P/2, causes a deflection of the coiled bar which is opposite in direction to the deflection due to torque and amounts to $f''' = \frac{4.8.\frac{P}{2}.L}{\pi.d^2.G}$ For the coiled bar L =

f" is the pure shear deflection of a cantilever bar as shown in fig. 1.

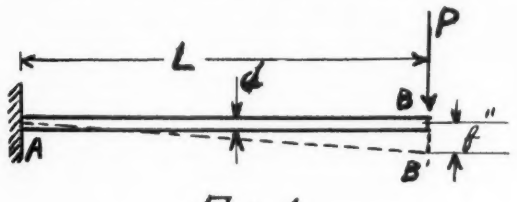


Fig 1

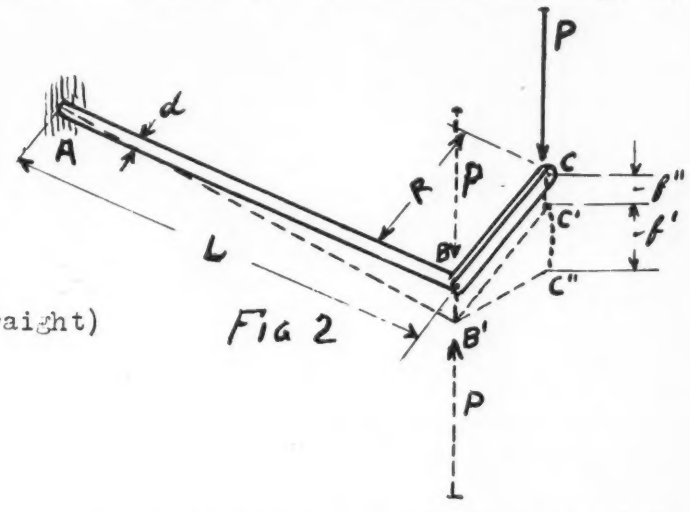


Fig 2

(Deflection lines A B' are straight)

If P is acting on the end of the cantilever L by means of a crank lever R as shown in fig. 2, a torsional deflection is produced to which the pure shear deflection must be added. As indicated in fig. 2, the end B and also C drop to B′ and C′, respectively, due to shear action of load P. The end C drops from C′ to C″ due to the twist in bar AB produced by torque P.R. The total twist angle at B amounts to $\omega = \frac{32.R.P.L}{\pi.d^4.G}$ and the arc from C′ to C″, the deflection due to torque P.R is $f' = R\omega = \frac{32.R^2.P.L}{\pi.d^4.G}$. The total movement of point C is

$$f' + f'' = \frac{32.R^2.P.L}{\pi.d^4.G} + \frac{4.8.P.L}{\pi.d^2.G} = \frac{P.L}{\pi.d^2.G}(32.\frac{R^2}{d^2} + 4.8)$$

✦ ✦ ✦

THIS deflection, however, is only correct for a straight bar of the length L. When this bar is coiled the deflection for torsion becomes less. This conclusion is drawn from the development of Dr. Ing. A. Röver's equation for torsional stress in a helical spring as given in VDI of November 29, 1913, page

2R π n, if R is the radius of curvature and n the number of coils.

Then $f''' = \frac{4.8.P.R.n}{d^2.G}$

$$f' + f'' = \frac{P.L}{\pi.d^2.G}.(32.\frac{R^2}{d^2} + 4.8) = \frac{P.R.n}{d^2.G}.(64.\frac{R^2}{d^2} + 9.6)$$

The total deflection is $f = f' + f'' - f'''$ or

$$f = \frac{P.R.n}{d^2.G}(64.\frac{R^2}{d^2} + 4.8) = \frac{P.D.n}{d^2.G}(8.\frac{D^2}{d^2} + 2.4) \qquad (\text{for } R = \tfrac{D}{2})$$

for $\frac{d}{D} = \eta$ and $P = \frac{S.d^3(1-\frac{d}{D})}{3.6.D}$ for tension springs

or $P = \frac{S.d^3(1-\frac{d}{D})}{3.28.D}$ for compression springs

$$\frac{f}{d.n} = \frac{S}{3.6.G}.\left[8.\frac{1-\eta}{\eta^4} + 2.4.(1-\eta)\right] \quad \text{for tension springs}$$

$$\frac{f}{d.n} = \frac{S}{3.28.G}.\left[8.\frac{1-\eta}{\eta^4} + 2.4.(1-\eta)\right] \quad \text{for compression springs}$$

✦ ✦ ✦

THE deflection curves included with this paper correspond with this value for the total spring deflection. Applying this revised equation to spring deflections found in accurate tests will result in finding a more uniform value for the torsional modulus of elasticity G which heretofore was found to be inconsistent for varying spring indices.

(*Please turn to page 217*)

Save on Your

Winding Costs

With Winco PRODUCTS Leakproof Enameled Wire

▲ ▲ ▲ All wire meets the most exacting requirements ▲ ▲ ▲

Your product will improve in

QUALITY

by the use of

Winco PRODUCTS LEAKPROOF ENAMELED WIRE

A wire made to the highest standard of uniformity in regard to dimensions, electrical properties and resistance to abrasions.

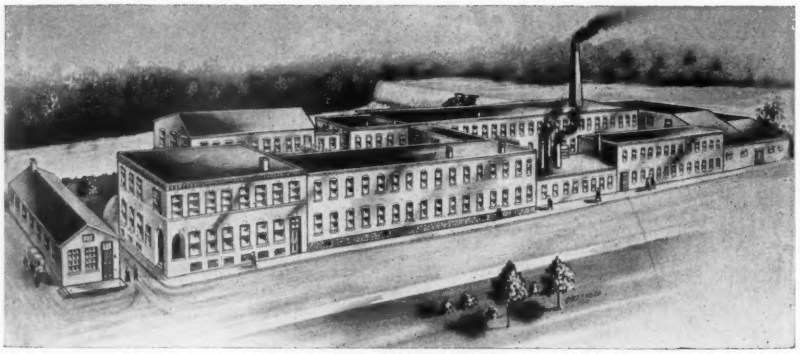
Allows of multiple winding without bunching, wrinkling or breaking of papers.

Permits the coil designor to calculate wire space accurately.

The ample coating of high dielectric enamel insures against the destructive effect of leakage currents, materially increasing the life of coils.

The enamel is especially resistant to the softening action of impregnating and baking compounds.

Write for samples.



GENERAL VIEW OF PLANT, WINSTED, CONN. ▲ ▲ ▲

Products of leakage currents attack insulation and shorten the life of the coil. ▲ ▲

The only test indicating what the leakage loss in a winding may be is the test in mercury, which reveals the weak spots in the enamel covering. ▲ ▲ ▲

Our method of testing all wire by mercury test before shipment is calculated to give the user the highest degree of protection. ▲ ▲ ▲

ALL Winco PRODUCTS WIRE

GUARANTEED LEAK PROOF ▲ ▲ ▲

We would be pleased to quote on your requirements.

WINSTED INSULATED WIRE COMPANY

Incorporated

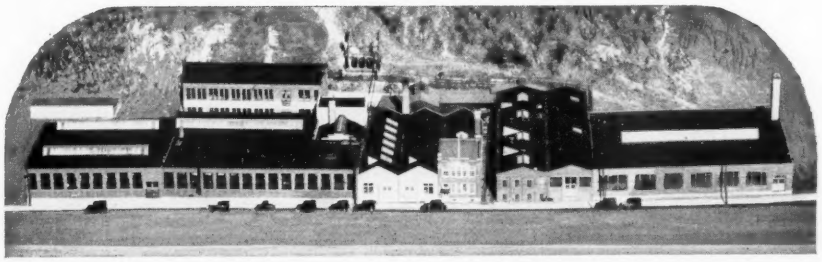
Winsted, Connecticut

"HUDCO" PRODUCTS ▲▲▲

Specially Processed Copper Wire ▲▲▲

For Enameling Purposes ▲▲▲

▲▲▲ Electrolytic and Oxygen Free ▲▲▲



AERIAL VIEW OF PLANT OF HUDSON WIRE CO., OSSINING, N. Y. ▲▲▲
▼▼▼ FINE WIRE MANUFACTURERS ▼▼▼

"HUDCO" High Conductivity Electric Wire

OTHER FINE BARE WIRES

High Brass, Low Brass, Zinc 99.99+ and High Tensile Zinc, Commercial Bronze Phosphor Bronze, Pure Tin, Lead, Antimonial Lead, Cadmium, 10%, 18% and 30% Nickel Silver, Silver Plated Copper, False Gold and Special Brass and Bronze Alloys to Specification.

BRUSH WIRES, CRIMP and STRAIGHT

Brass, Steel, Nickel Silver, Copper and Phosphor Bronze

TINSEL LAHNS

Silver Plated Copper, False Gold and Copper

METALLIC FIBRE FOR PACKING PURPOSES

Copper, Bronze, Zinc, Lead and Aluminum

Wires for Metal Sprays

Zinc, Tin, Lead, Copper, Commercial Bronze, High Brass, Low Brass, Cadmium, 10% Nickel Silver, 18% Nickel Silver, Aluminum, Monel Metal, Phosphor Bronze, Pure Nickel. Other wires to specification.

"Hudco" copper wire is drawn by the Hudson Wire Company of Ossining, N. Y., who have been specialists in the manufacture of fine wires for over thirty years. ▲

The best grade of copper drawing stock is used, insuring the maximum conductivity. ▲▲▲

A new process of drawing and annealing is used which produces a wire unusually smooth, clean and uniform in color for enameling and other purposes. ▲▲▲

Painstaking care in the selection and maintenance of dies guarantees a product accurate to gauge and resistance. ▲▲▲

You can rely on "Hudco" wire always. ▲▲▲

Expert annealing of the wire prevents unnecessary breakage when winding the wire into coils. ▲▲▲

If you, too, have a specific problem demanding wire of exact requirements, write to us about it. ▲▲▲

It costs nothing and involves you in nothing. ▲▲▲

Better wire at lower cost. ▲▲▲

"HUDCO"
FINE WIRES

We can serve you quickly and economically.
Send in your specifications for a quotation.

HUDSON WIRE COMPANY

Ossining, N. Y.

Estab. 1902 — Successors ROYLE & AKIN — Estab. 1902

"HUDCO"
FINE WIRES

Fatigue Tests of Helical Springs[1]
and
Notes on Sundry Results of the Tests

C. T. Edgerton
Manager Bureau of Statistics, Crucible Steel Co. of America

Progress Report No. 2 of the Sub-Committee[2] on Heavy Helical Springs of the A. S. M. E. Special Research Committee on Mechanical Springs

THE sub-committee reports that the fatigue tests on groups 5 and 6 have been completed, making a total of five groups of three springs each tested. Tests on group 4 are still incomplete.

✦ ✦ ✦

THE only variable so far applied in these tests has been the stress range, all other conditions being maintained as nearly as possible constant. Material in all cases was 1 in. round plain-carbon steel, about 1% carbon, and was coiled to 6 in. outside diameter of helix, the free height varying with the stress range to be applied. In general the solid fiber stress ran about 10,000 lb. per sq. in. above the upper stress limit for the endurance test, figured without the Wahl correction. The heat treatment was an oil quench from 1525 F and a draw to 575 F. Brinell hardness on all springs was within the range 373 to 415. A more detailed description of the methods of test, measurements, etc. may be found in the sub-committee's tentative program, which has been given general circulation.

✦ ✦ ✦

TABLE 1 shows the results of the fatigue tests, completed to date.

✦ ✦ ✦

IT had been the intention to test group 5 at a 0-105000 stress range. On subjecting the springs to the load and calibration tests, it was found that they were practically solid at heights corresponding to about 105000 stress, and the stress range for the life test was accordingly dropped to 0-95000. Some of the test results indicate that the springs in this group are not 100%. The reason for this may perhaps be developed by the metallurgical examination, which has not yet been completed.

TABLE 1

Group No.	Stress Range	Spring A		Spring B		Spring C		Average
1	0-75000	600000	(1)	600000	(1)	600000	(1)	600000
2	0-75000	200000	(1)	200000	(1)	200000	(1)	200000
3	0-75000	600000	(1)	330000		590000		506667
4	0-90000	Tests not completed						
5	0-95000	40800		31900		11900	(2)	36350
6	0-95000	74530		48000		89130		70533

Note (1) Specimen did not fail; test discontinued.
Note (2) Bad surface seam; result excluded from average.

5 and 6, in the same form as used in Progress Report No. 1, for the first four groups. The notation:

a_o is the slope of the probable load-deflection graph (assumed a straight line), using overall measurements

a_p is a similar slope using prick-point measurements over four active coils

TABLE 2

	Spring A	Spring B	Spring C	Average
Group 5				
a_o	0.5734″	0.5752″	0.5713″	0.5733″
a_n	0.3796″	0.3781″	0.3776″	0.3784″
n_a	6.04	6.09	6.05	6.06
f	0.0949″	0.0945″	0.0944″	0.0946″
G	10,840,000	10,860,000	10,820,000	10,870,000
C	8,690 lbs.	8,440 lbs.	8,490 lbs.	8,540 lbs.
S	112,000	108,700	109,500	110,100
k	6.042	6.042	6.048	6.044
S_w	146,500	142,200	143,100	143,900
Group 6				
a_o	0.5558″	0.5562″	0.5533″	0.5551″
a_n	0.3626″	0.3642″	0.3662″	0.3643″
n_a	6.13	6.11	6.04	6.09
f	0.0907″	0.0911″	0.0916″	0.0911″
G	11,299,000	11,100,000	11,202,000	11,200,000
C	8,977 lbs.	8,745 lbs.	9,039 lbs.	8,920 lbs.
S	115,800	111,900	116,600	114,800
k	6.035	6.016	6.037	6.029
S_w	151,500	146,600	152,500	150,200

IT is impossible to draw any definite conclusions from these few tests, but there might be hazarded a guess that the endurance limit, for the test conditions, will be found at about 70000 lb. per sq. in. maximum fiber stress.

✦ ✦ ✦

TABLE 2 shows an analysis of the static test results on groups

n_a is active coils, obtained by proportion from a_o and a_p

f is deflection per coil per 1000 load increment

G is the figured torsional modulus

C is the nominal capacity or load required to close the spring solid, being obtained by extrapolation of the probable load-deflection graph

[1]Contributed by the Special Research Committee on Mechanical Springs for presentation at the Mechanical Springs Session of the Semi-Annual meeting of The American Society of Mechanical Engineers, Chicago, Ill., June 25-30, 1933.

[2]The personnel of the subcommittee is as follows: C. T. Edgerton, **Chairman**, Manager Bureau of Statistics, Crucible Steel Company of America, New York, N. Y.; David Lofts, Cincinnati, Ohio; A. N. Lukens, Chief Engineer, Railway Steel Spring Co., New York, N. Y.; M. F. Sayre, Assistant Professor of Applied Mechanics, Union College, Schenectady, N. Y.; Keith Williams, Vice President and General Manager, Pratt & Letchworth Co., Buffalo, N. Y.

S is the figured maximum fiber stress, without the Wahl correction

k the spring index, outside diam./diam. of steel

S_w is the maximum fiber stress, using the Wahl correction.

✦ ✦ ✦

GRAPHS, the logical means of bringing out some very suggestive variations in certain of these results, cannot be used in this abstract. However, a comparison of active coils and torsional modulus for the six groups shows a systematic trend in these two quantities; the active coils increasing and the modulus decreasing, as the solid fiber stress increases. The variations in stress are of course produced by varying the initial height to which the spring is coiled. It will be found advantageous to relate the aforementioned variations to the following index, which will be designated as the "hot set ratio." If H_i be the coiling height, or height before test, H be the free height after static test, E be the solid height, then the hot set ratio, by definition, will be H^i—E/H—E.

✦ ✦ ✦

IN Table 3 is shown a comparison, for the eighteen springs tested so far, of the hot set ratios, the solid fiber stresses, the number of active coils, and the torsional modulus values. Tables 4 and 5 cover comparisons of Spring A of groups 1 and 6.

✦ ✦ ✦

THE hot set ratios for Group Four are not available at the moment.

✦ ✦ ✦

WHILE there is some random variation within each group, the general trend of these figures is quite marked. The increase in the solid stress as the hot set ratio increases is of course due to the presence of "entrapped stresses". The writer has attempted to treat this relation of stress and hot set ratio mathematically, with rather encouraging results; but additional data are required to define the relation by a workably accurate formula. A similar attack on the relation of hot set ratio and torsional modulus has been entirely unsuccessful; and it would appear that the decrease in the modulus, as noted, is simply an indication of weakening or perhaps incipient failure of the material.

TABLE 3

Group	Supring	Hot Set Ratio	Solid Stress	Active Coils	Torsional Modulus
One	A	1.075	87,100	6.01	11,881,000
"	B	1.078	86,900	5.75	11,596,000
"	C	1.068	89,600	5.89	11,681,000
Two	A	1.025	67,575	5.91	11,496,000
"	B	1.033	76,300	6.05	12,531,000
"	C	1.022	76,200	5.72	11,920,000
Three	A	1.114	87,500	5.99	11,800,000
"	B	1.105	80,200	5.77	11,080,000
"	C	1.101	81,300	6.04	11,450,000
Four	A		106,000	6.12	12,085,000
"	B		107,300	6.35	11,852,000
"	C		102,600	6.08	11,389,000
Five	A	1.867	112,000	6.04	10,840,000
"	B	1.908	108,700	6.09	10,860,000
"	C	1.910	109,500	6.05	10,920,000
Six	A	1.646	115,800	6.13	11,299,000
"	B	1.674	111,900	6.11	11,100,000
"	C	1,682	116,600	6.04	11,202,000

TABLE 4

Loads	Compression Deflection	Compression Variation	Str. Line Defl.	Release Variation	Release Deflection
Free	0	–	0	–	0
1000	.350	+.019	.331	+.039	.370
2000	.680	+.018	.662	+.038	.700
3000	1.000	+.007	.993	+.047	1.040
4000	1.320	—.004	1.324	+.026	1.350
5000	1.640	—.015	1.655	+.015	1.670
6000	2.010	+.024	1.986	+.034	2.020
Solid	2.30	–	2.30	–	2.30

TABLE 5

Loads	Compression Deflection	Compression Variation	Str. Line Defl.	Release Variation	Release Deflection
Free	0	–	0	–	0
1000	.375	+.012	.363	+.112	.475
2000	.725	0	.725	+.170	.895
3000	1.085	—.003	1.088	+.207	1.295
4000	1.440	—.010	1.450	+.215	1.665
5000	1.810	—.003	1.813	+.212	2.025
6000	2.185	+.009	2.176	+.199	2.375
7000	2.595	+.057	2.538	+.187	2.725
8000	3.055	+.154	2.901	+.204	3.105
Solid	3.255	–	3.255	–	3.255

✦ ✦ ✦

ANOTHER interesting spring phenomenon on which our tests afford some data is the difference between "compression" and "release" heights in the load tests. Here again we find evidence of some relation with the hot set ratio.

✦ ✦ ✦

IN the absence of graphs, the point to be made can be illustrated as follows. Take as an example Spring "A" of Group One. The column in TABLE 4 headed "Straight Line Deflection" shows theoretical deflections which are accurately proportional to the tabulated loads, the ratio used being that of the nominal capacity to the observed total movement. In the two columns to the left of this are the actual observed deflections in compression, and the difference between these and the straight line deflections; in the two columns on the right are similar figures for the deflections on release test. All deflections are from prick point measurements on active coils.

✦ ✦ ✦

NOTE that the variations on the compression side from

(*Please turn to page 220*)

A Review of Recent Wire Patents

No. 1,904,116, STEEL ALUMINUM CABLE, Patented April 18, 1933, by Reinhold Baum of Cologne-Mulheim, Germany, assignor to Felten & Guilleaume Carlswerk Actiengesellschaft of Cologne-Mulheim, Germany.

An object of this invention is to provide a stranded steel aluminum electrical cable made free from twists by equalizing the oppositely directed turning movements of the layers of wires with a ratio of cross-section of aluminum to steel of about 6:1 and laying lengths about 11-14 times the diameter of the cable, in which the steel wires are disposed over the whole cross-section of the cable, partly in the middle of the cable and partly in layers together with the aluminum wires.

✦ ✦ ✦

No. 1,904,146, WIRE DRAWING APPARATUS, Patented April 18, 1933, by Einer W. Larson of Chicago, Illinois, assignor to Western Electric Company, Incorporated of New York, N. Y., a Corporation of New York.

Particularly, the invention relates to a machine for pointing or swaging the end of a rod of wire and stringing or positioning thereon a die preparatory to reducing the cross-section of the rod or wire. The device is mounted axially within a rotatable drum adapted to draw the wire through a succession of dies individually. The pointing device and the drawing drum are each operated independently of the other from a driving shaft co-axial therewith by means of individual clutching means, dependent solely on the direction of motion of the driving shaft.

✦ ✦ ✦

No. 1,904,147, WIRE DRAWING MACHINE, Patented April 18, 1933 by Einer W. Larson of Chicago, Illinois, assignor to Western Electric Company, Incorporated of New York, N. Y., a Corporation of New York.

The construction includes a wire drawing chamber, of four shafts arranged in a rectangular formation, two being driven by a gearing from a suitable source of power to rotate stepped capstans mounted thereon, and others being stationary inclined slightly, and carrying idler sheaves over which pass the wire being drawn by the capstans. The chamber is provided with quick closing doors which, being mounted upon pivoted L-shaped members, are movable to close the chamber after stringing, with a liquid-tight seal by means of bifurcated racks which, moving in one direction, rotate the L-shaped members to bring them together and then carry them bodily forward in closed position to tightly seal the aperture while the machine is in operation.

✦ ✦ ✦

No. 1,904,159, WIRE DRAWING MACHINE, Patented April 18, 1933, by Edwin J. McIlvried of Cleveland, Ohio, assignor by mesne assignments to Western Electric Company, Incorporated of New York, N. Y., a Corporation of New York.

In this patent, the invention lies particularly in a new arrangement of the

Complete Descriptions and Drawings Address, Wire & Wire Products, 17 East 42nd St., New York. of Patents May Be Had for 25 cents.

---

delivery end of a wire drawing machine so that the operator can change and adapt the machine from spooling to coiling in a comparatively short time.

✦ ✦ ✦

No. 1,904,162, ELECTRICAL CABLE, Patented April 18, 1933, by Humphreys Milliken of Mount Royal, Montreal, Quebec, Canada.

In order to reduce the skin effect, the inventor provides a cable for alternating power currents, composed of a number of sectors helically arranged around the axis of the cable, each of the sectors being composed of a number of layers of solid wires, each layer being separate and continuous throughout the entire length of the cable, and each wire continuing in the same layer throughout the length of the cable and being helically arranged around the axis of its segment, all of the wires and sectors being of the same polarity and connected together electrically at each end of the cable and having sufficient contact-resistance between adjacent wires throughout the length of the cable to tend to prevent current flowing between adjacent wires.

✦ ✦ ✦

No. 1,904,947, WIRE DRAWING MACHINE, Patented April 18, 1933, by Jacob T. Leech of Beaver, Pennsylvania, assignor to Union Drawn Steel Company of Beaver Falls, Pennsylvania, a Corporation of Pennsylvania.

Particularly, the invention relates to a pusher capable of providing continuous support for the wire for the entire distance between the die and the clamp of the pusher mechanism. The guides for the wire are telescopically arranged so as to arrange for the travel of the pusher mechanism and still keep the wire confined between such guides.

✦ ✦ ✦

No. 1,904,965, WIRE DRAWING MECHANISM, Patented April 18, 1933 by Alfred T. Yungman of Akron, Ohio, assignor to The Vaughn Machinery Company of Cuyahoga Falls, Ohio, a Corporation of Ohio.

More particularly, the invention relates to that type of wire drawing bench which comprises a number of blocks carrying dies and drawing drums. The primary object of the invention is to aim to increase the flexibility of use of such a bench.

✦ ✦ ✦

No. 1,905,046, MACHINE FOR FEEDING COILED SECTIONS, Patented April 25, 1933, by Charles A. Nicolai and Erik Lindegaard of Bloomfield, New Jersey, assignors to Westinghouse Lamp Company, a Corporation of Pennsylvania.

One of the objects of the invention is to provide manipulated coil gripping tongs which will pick up a coiled section and transport the same to a given position and is particularly adapted for use in machines for the manufacture of incandescent lamps employing very fine wire.

✦ ✦ ✦

No. 1,905,086, WIRE FABRIC MAKING MACHINE, Patented April 25, 1933, by Israel C. Gellman of Rock Island, Illinois, assignor to Northwestern Barb Wire Company of Sterling, Illinois, a Corporation of Illinois.

Particularly, the machine is adapted for the manufacture of wire fences employing both line and mesh wires and weaving the wire to form a fabric of substantially hexagon design. However, the machine may be easily adapted for the weaving of fencing without the employment of line wires.

✦ ✦ ✦

No. 1,905,160, KNITTED METALLIC FABRIC, Patented April 25, 1933, by Frederick De Angelis of West Orange, New Jersey, assignor to Metal Textile Corporation, a Corporation of Delaware.

This fabric is particularly intended for use as an abrasive as in scouring and comprises a carrying cord upon and around which is more or less loosely gimped or convolved coils of a preferably flat or ribbon-like metallic wire with ties at intervals to secure the metallic wire coils in groups.

✦ ✦ ✦

No. 1,905,197, FLEXIBLE CABLE, Patented April 25, 1933, by Hartwell W. Webb of Flint, Michigan, assignor to A C Spark Plug Company, of Flint, Michigan, a Company of Michigan.

This cable comprises a number of wires with a phosphor bronze core wire and a number of layers of wire wrapped around in alternatingly opposite directions over the core wire, not more than two of the layers having their wires of the same diameter.

✦ ✦ ✦

No. 1,905,317, CABLE SHEARING MECHANISM, Patented April 25, 1933, by Henry A. Stringfellow of Philadelphia, Pennsylvania, assignor to Southwark Foundry & Machine Company, of Eddystone, Pennsylvania, a Corporation of Pennsylvania.

The inventor provides a shear mechanism with a plurality of clamping devices disposed on opposite sides of the shear blades, one of the clamping devices serving as a fixed element during the shearing action and engaging the portion of cable from which a length is being sheared.

✦ ✦ ✦

No. 1,905,803, WIRE DRAWING MACHINE, Patented April 25, 1933, by Ernest W. Clark of Schenectady, New York, assignor to General Electric Company, a Corporation of New York.

The invention is particularly directed to the arrangement of the driving mechanism whereby the drawing rolls of the wire drawing machine are positively driven at different speeds from one centrally disposed shaft, as well as to the arrangement of parts whereby horizontal drawing rolls and dies are supported (in rows) one above the other on the front side of a vertical partition so that the wires may be readily threaded through the dies and around the rolls.

(Please turn to page 221)

Exports and Imports of Wire

Exports of iron and steel wire products in April, 1933 and April, 1932
(In gross tons)

	April 1933	March 1933	April 1932
Wire rods	1,488	148	1,178
Hoops, bands and strip steel	1,102	1,276	1,743
Plain black or galvanized iron or steel wire	567	571	1,124
Barbed wire and woven wire fencing	1,111	1,691	2,293
Woven wire screen cloth	42	73	68
Wire rope	141	233	144
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	251	179	161
Wire nails	431	482	781
Tacks	33	36	32
Other nails, including staples	167	153	275
Bolts, machine screws, nuts, rivets, and washers	282	312	224
Total, these 11 classifications	5,615	5,154	8,023

Imports of iron and steel wire and wire products into the United States
(In gross tons)

Concrete reinforcement bars	150	303	2,650
Hollow bars and drill steel	94	74	93
Merchant steel bars	951	1,506	3,316
Wire rods	542	1,017	276
Barbed wire	456	799	1,390
Round iron and steel wire	244	420	223
Telephone and telegraph wire	....	....	....
Flat wire and strip steel	46	71	84
Wire rope and strand	145	116	202
Other wire	261	116	112
Hoops and bands	1,031	1,077	1,889
Nails, tacks and staples	323	620	995
Bolts, nuts and rivets	37	11	11
Total, these 13 classifications	4,280	6,014	11,241

Exports of Insulated Wire and Cable
April, 1933

	Lbs.	Value
Insulated iron or steel wire and cable	31	$ 17
Rubber covered wire	258,592	35,730
Insulated copper weatherproof wire	62,366	8,592
Wire and cable telephone cable	2,657	1,742
Other insulated copper wire	149,436	29,069
Nickel-Chrome Electric Resistance Wire	10,282	13,876
Total, these 6 classifications	483,364	$89.026

AGAIN aided by increased shipments of scrap, the export trade in iron and steel products continued to rise sharply during April—being greater by 25 percent than the March shipments. Exports totaled 100,395 gross tons, which represents the highest monthly total attained since April, 1931, while they exceeded the April, 1932 shipments by approximately 73 percent. A daily average of 3,013 tons was maintained during the month—414 tons greater than that maintained during March.

✦ ✦ ✦

IMPORTS at 28,061 gross tons recorded an increase amounting to 5,947 tons over the March trade, but were still considerably below the total of 35,935 tons recorded during April, 1932.

EXPORTS during the first four months of the year totaled 301,618 tons and were 112,454 tons greater than in the same period of 1932. This increase, however, is largely represented in the greatly augmented sales of scrap iron and steel which have risen from a total of 48,758 tons recorded during the first four months of 1932 to 201,195 tons in the present year. The import trade was still considerably below the 134,757 ton total recorded last year and amounted to 91,815 tons.

✦ ✦ ✦

THE export total for April—100,395 tons—exceeded that of March by 19,828 tons, a gain of 24.5 percent. With no exports reported in either month in two classes of products, there were 27 items in which exports rose as compared to 32 classes in which they declined. In point of tonnage, the most important items in the trade were scrap, which gained 16,197 tons to total 73,719 tons.

✦ ✦ ✦

JAPAN maintained her position as the largest purchaser of these products by taking a total of 51,296 tons, of which 48,253 tons were scrap and 1,425 tons—representing the next largest item in this trade—were wire rods. Germany purchased 12,400 tons, 12,104 tons of which were scrap, while Italy took 7,765 tons of scrap out of total purchases amounting to 8,015. Steel bars (830) tons, hoops and bands (753) tons, and black steel sheets (710) tons were the principal items entering into our (5,869) ton trade with Canada. Poland, which bought (4,106) tons of these products, confined her purchases almost entirely to scrap with (4,091) tons, and the Phillippine Islands (3,310) tons took principally galvanized steel sheets (1,213) tons, while China took (596) tons of scrap.

✦ ✦ ✦

FOR the second consecutive month, imports in April showed an increase over that of the preceding period. At 28,061 gross tons, the trade of this month gained 5,947 tons or 27 percent. The trade trend, as shown by volume of individual classifications, remained stationary, there being 15 losses to offset the 15 cases of increased receipts. There were such losses as 555 tons in merchant steel bars, 475 tons in wire rods and 342 tons in scrap trade. The cumulative total for the first four months of the current year, 91,815 tons, showed a loss of 42,942 tons as compared with a similar 1932 figure.

✦ ✦ ✦

BRITISH India, with shipments totaling 10,803 tons (all pig iron) captured first place as supplier of iron and steel in April. Belgium's total was 3,587 tons, nearly half of which was structural shapes with hoops and bands and sheets, and merchant steel bars also figuring prominently. The German trade of 2,334 tons included barbed wire, hoops and

(*Please turn to page 217*)

'Round the World With the Wire Industry

British Copper Development Association

ON the initiative of the Rhodesian and Canadian Copper producers a conference of leading representatives of the copper trade was held in London recently under the chairmanship of A. Chester Beatty, when it was decided to form a copper development association.

✦ ✦ ✦

ALTHOUGH there have existed for some years various trade associations representing certain sections of the copper industry, there has so far been no central co-ordinating development body for all branches of the industry. The new association will have as its object the collection of technical and cognate information on the use of copper and the dissemination of this information to consumers and potential users of copper. The association will be under the control of a council on which the various interests, including those of copper wire-drawing enterprises, will have representation, and immediately after incorporation will start work with headquarters at Thames House, Billbank, London.

✦ ✦ ✦

British Bolt Firms Merge

THE amalgamation has just taken place of the two oldest bolt-making enterprises in the Manchester industrial district, Samuel Marsden & Sons and Richard Davies & Sons. Important economies are expected to result from the merger.

✦ ✦ ✦

Improved Electrical Coil Wire

A new invention concerned with the production of heater wires of electrical coils has been taken out in England by the Vereinigte Stahlwerke A.-G. The wire possesses both a high resistivity and a high temperature coefficient. Chromium steels are used for the purpose, and they contain a greater amount of aluminum then chromium. The general range covered is 1.8 to 5 per cent of chromium and 7.5 to 12 per cent of aluminum.

✦ ✦ ✦

IN an example quoted in the specification a steel having 2.2 per cent chromium and 7.8 per cent of aluminum, together with small quantities (up to 2 per cent) of silicon, nickel, etc., has a resistance, in 1 meter lengths, at 20 degrees C. of 0.93 ohms per square mm. section, a figure which increases to 1.54 ohms at 1,000 degrees c. It is stated that these wires do not scale very readily.

✦ ✦ ✦

German Rod Cartel Wants Increased Import Duty

THE German wire rod cartel demands an increase of the import duty on wire rods to 40 marks per ton (present duty 25 marks). Imports of wire rods into Germany show a very sharp rise and the imported tonnage is now more than 3000 tons monthly, chiefly of French and British origin. The German cartel has been forced to revise prices in certain districts. The Reich's Commissar has put a stop to the selling at higher prices of wire to people outside the wire cartel. The cartel was threatened by forceful immediate dissolution unless the same prices were quoted to all German buyers.

German Method of Shipping Barbed Wire

Change in German Wire Netting Exports

IT is interesting to note the change in wire netting exports. In 1925 95% of all wire netting exported was galvanized after it was made, and only 5% of it was made of galvanized wire. In 1930 that galvanized after completion amounted to approximately 80% of total exports. In 1932 this dropped to 67% and is now 60%, and it is probable that a 50%-50% parity will be reached at the end of this year. The market is showing greater preference toward wire netting made from galvanized wire, particularly as it is now offered at 5 to 7½% cheaper.

✦ ✦ ✦

Germany Develops New Type Drums For Wire Rope

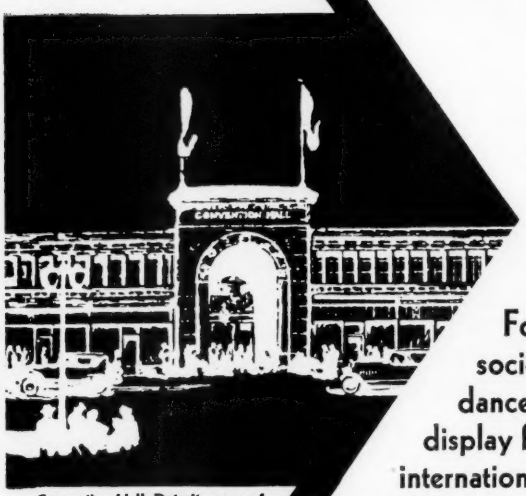
NEW types of drums are being used here for wire rope making. These consist of two parts which can be easily taken apart and which are inserted into the winder of wire rope making machines in order to wind up the finished rope into coils. The particular advantage of this drum lies in the fact, that the bundling of the coil can be carried out direct upon the drum, a process which is not possible upon drums consisting of one part, on which the finished rope must be first unwound in order to be bundled. This means a large saving in time and wages.

✦ ✦ ✦

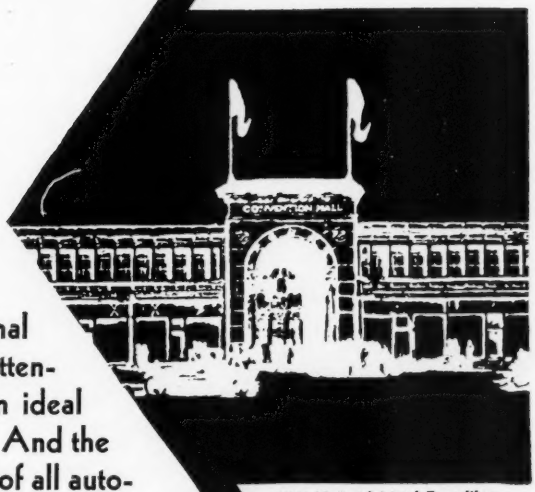
THESE drums in any size and with strong flanges are now commonly used for wire rope making. For birdcage machines, for horizontal wire rope making up to 30 spools and for cable stranding machines it is now customary in Germany factories to use ball bearings for supporting rollers of smaller output and roller bearings on larger output.

No better place to display your material, equipment, or process, than at

THE FOCAL POINT OF THE METAL YEAR



Convention Hall, Detroit, scene of 1933 National Metal Exposition



Four national societies in attendance. . . . An ideal display floor. . . . And the international capital of all automobiledom . . . as the background for your exhibit.

Commitments already received indicate a bigger National Metal Exposition than in any recent year. Write, wire, or phone for full details to . . . American Society for Steel Treating, 7016 Euclid Avenue, Cleveland, Ohio.

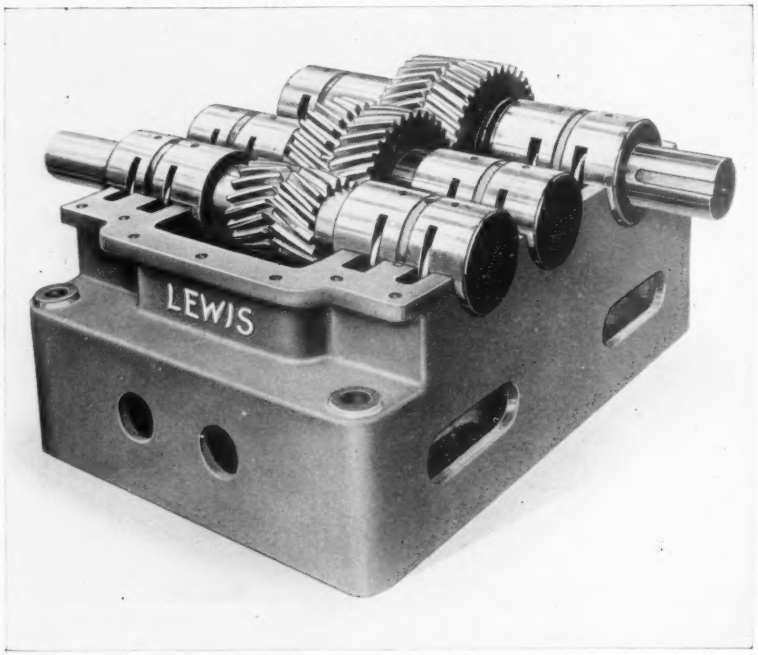
Societies in attendance at this year's Metal Congress include: American Society for Steel Treating, American Welding Society, The Wire Association, Institute of Metals and Iron and Steel Divisions of the American Institute of Mining and Metallurgical Engineers.

DETROIT OCT. 2-6, (Inc.) 1933 METAL CONGRESS

LEWIS

+ + + + + HIGH SPEED GEAR SET

FOR CONTINUOUS ROD MILL



Lewis High Speed Gear Sets are in use where quality and efficiency really count. The largest and most up-to-date rod mill unit in the world utilizes Lewis Gear Sets for driving its roll stands.

Lewis gear housings are of two piece type with special alloy forged steel herringbone cut tooth gears running in babitted shell type or roller bearings. One Lewis gear set is used for driving two roll stands which is a special feature for controlling roll speeds when driven by either individual motors or bevel gear drives. Lewis gear sets are totally enclosed and gears and bearings run continuously in oil.

Lewis Engineers will gladly cooperate with you in designing special machinery to meet your problems.

THE LEWIS FOUNDRY & MACHINE CO.
BOX 1591
PITTSBURGH, PA.

IWECO NOTES

THE price war on the market for hexagonal wire netting is showing a further accentuation and the IWECO is unable to control the business. The present rebate off the international standard list is only 90% f. o. b.

+ + +

IT is probable that the depreciation of the dollar and the circumstance that the American wire industry has maintained the quotations in dollars which actually means a heavy decline of prices compared with the IWECO quotations, might force the IWECO to reduce prices for certain markets. At the moment only the prices for barbed wire and fencing wire have been lowered for export to Venezuela and Cuba. All other prices are unaltered.

+ + +

THE Swedish wire nail industry has reported that it will join the IWECO. The Swedish nail industry started a vigorous campaign in Asia and Southern Europe with the result that more than 1300 tons of wire nails were exported, compared with 420 tons of last year and 187 tons the first quarter of 1931.

+ + +

The Duriron Company, Inc., Dayton, Ohio, is announcing the development of a **new metal alloy** that is almost entirely resistant to hydrochloric acid at all concentrations and all temperatures up to the boiling point. Hydrochloric acid, widely used commercially, is one of the most vicious acids for attacking metals. Heretofore, the only metals available for complete resistance have been very costly.

Durichlor (Dur-i-chlor), the name of the new alloy, is comparatively inexpensive and is being used to make pumps, valves, pipe, fittings, jets and other pieces of chemical handling equipment.

Make Your Plans Now
To Attend
The Wire Association Meeting
Detroit, Oct. 3-4-5-1933

Stresses in Helical Springs

(*Continued from page 207*)

ACCORDING to "Recommended Practice" approved by the Board of Directors and the Recommended Practice Committee of the American Society for Steel Treating, Spring Steel should be tempered for a Brinell hardness of 352 to 415 for carbon steel and 363 to 444 for alloy steel.

✦ ✦ ✦

THE corresponding yield points and tensile strengths are given in the following table:

	Steel	Brinell Hardness	Tensile Yield Point lbs/sq. in.	Ultimate Tensile Stress lbs/sq. in.
A.S.S.T.	(Carbon Spring Steel	352-415	158000-194000	176000-208000
	(Alloy Spring Steel	363-444	164000-210000	182000-220000
Huette	(Spring Steel CF)	370-426	170000-192000	185000-213000
	(Spring Steel BM) PC 300	400-452	175000-192000	199000-226000
	(Natural Hard	340-368	142000-156000	170000-184000
	(Piano Wire		170000-192000	185000-213000

✦ ✦ ✦

By applying the proper factor of safety the stresses given in above table may be directly used in formulas:

$$s' = \frac{3.6 \cdot P \cdot D}{d^3 \cdot (1 - \frac{d}{D})}$$ for tension springs

$$s'' = \frac{3.28 \cdot P \cdot D}{d^3 \cdot (1 - \frac{d}{D})}$$ for compression springs

'Round The World

(*Continued from page 213*)

bands, nails and sheets in moderate quantities.

✦ ✦ ✦

CARD clothing imports in April remained at nearly the same level as the preceding month and totaled 12,191 square feet valued at $10,454. The United Kingdom supplied the bulk of this item, 9,522 square feet valued at $8,942, Belgium accounted for 2,321 square feet valued at $1,178, Germany 288 square feet valued at $278, and Bulgaria 60 square feet valued at $56.

WIRE cloth and screening imports at 13,369 square feet were only about half as large as March shipments, 7,195 square feet coming from Germany and the balance from France. Fourdrinier and other paper making wire totaled 76,466 square feet, more than double the March receipts, with 37,688 square feet coming from Austria, 16,603 square feet from France, 15,618 square feet from Germany and 6,557 square feet from Sweden.

✦ ✦ ✦

IMPORTS of wire fencing and netting galvanized before weaving increased slightly to total 4,717,200 square feet, 2,939,400 square feet coming from Germany, 1,419,375 square feet from Belgium and 286,425 square feet from the Netherlands, while that galvanized after weaving decreased by nearly half to total 1,729,375 square feet of which 1,277,475 square feet originated in Germany, 228,150 square feet in the Netherlands and 223,750 square feet in Belgium. Wire heddle receipts declined to 330,000 pieces, 250,000 from France and 80,000 from Switzerland.

Shea Gutta

THIS substance has been known since the middle of last century as a product resulting from the tapping of the bark of the shea tree (Butyro - spermum Parkii). The tapping is carried out by the natives of the shea tree regions in West Africa, in a manner similar to the tapping of ordinary hevea rubber trees. From the cuts so made in the bark, a milky latex flows, which soon solidifies on exposure to the air or on evaporation of the moisture. The gutta so obtained is a hard, brittle product, generally having a light brown color. It is almost completely soluble in benzene, chloroform carbon - disulphide; only slightly soluble in petrol ether, and practically insoluble in methylated ether. Samples from West Africa examined for approximate composition have given the following average figures:

	Samples 1	2	3
Substances soluble in alcohol, (resins)	53%	57%	46.5%
True gutta	45%	49.7%	52.3%
Water soluble materials	1.5%	1.7%	1.3%
Ash	0.5%	0.6%	0.4%

THE crude substance softens in water at a temperature of 63 C and can then be moulded but regains its original hardness on cooling.

✦ ✦ ✦

IT would be possible to organize the collection of this material should a regular market be offered; but, so far, no serious business in this material has been attempted, so that it is not practicable to give you a reliable estimate of the quantities which would be available, nor of the price which it would be necessary to pay to secure adequate quantities.

✦ ✦ ✦

A small percentage of the gutta is present in the seeds, and is extracted along with the shea nut oil of commerce, appearing as "unsaponifiable matter" in the routine analysis of the shea nut oil; and giving great difficulties in the commercial utilization of the oil owing to the formation of emulsions.

✦ ✦ ✦

THERE is, however, in Nigerian trade, a product known as "NIGER GUTTA", extracted from a species of Ficus (F. platyphylla), which is stated to be quite similar to the gutta made from the latex of the shea tree. This substance forms a current article of commerce and is obtainable at a price of approximately 6d per lb. delivered U. S. A.

Registry of Used Wire Machinery

Conducted by

Dunscomb Associates

BOX 320, C/O WIRE AND WIRE PRODUCTS 17 EAST 42nd ST., NEW YORK, N. Y.

We Offer—Subject to Prior Sale—The Following Used Wire Mill Machinery

No. 230

Morgan Rod Bench
6-22″ Friction Blocks
Gear Drive and Motor
2 Pointers
Block Speeds, 28 to 34 R. P. M.

No. 241A

10 block music wire bench with 16″ blocks.
Complete with gear and chain drive, Motor and starter.

No. 302

For Sale

9 Die Richards
Continuous Machine
For Copper Rod

No. 231

Fifteen Frame for Wet Drawing
10 Blocks 12″ Dia.
Block Speed 35 R. P. M.
McMahon Pinions

No. 280

One Nilson Wire Straightening and Cutting Machine, with horizontal and vertical rolls, 3/16″ capacity.

No. 320

For Sale
12 Spindle, 24 Block — 16″ Dia.
Galvanizing Take-Up Frame
Reeves Class F Variable Speed Transmission
For No. 14 to No. 22 Wire

No. 282

One Waterbury Farrel Foundry New No. 1 Continuous Wire Drawing Machine, with Spooling Attachment

No. 285

3 Shuster ⅜″, and ½″ capacity by 10′ automatic wire straightening and cutting machines.

No. 321

Electric Platform Truck
Capacity 6000 lbs.
Platform 41″ x 82″ x 22½″ High
24 Cells Edison A-6 Batteries

WE HAVE BUYERS FOR THE FOLLOWING

No. 290

SIXTEEN WIRE GALVANIZING
OUTFIT WITH 12-22″ and 4-18″ blocks, horizontal spindle type, preferably complete, but would consider take-up alone.

No. 291

Wanted
Lewis Automatic Straightening and Cutting Machine

No. 292

Wanted
Automatic Four Slide Forming Machines

No. 293

Wanted
Sleeper & Hartley Universal Spring Coilers

No. 301

Wanted
19 Bobbin Tubular Stranding Machines

No. 310

Wanted
Equipment For Tinning Wire

No. 311

Wanted
Equipment for Drawing Bright Wire From No. 22 to No. 30

No. 314

Wanted
Equipment for Hexagon Poultry Netting — Sizes from ½″ mesh 3 feet wide, 24 ga. to 2″ mesh 6 feet wide, No. 19 ga.

No. 315

Wanted
Dumore Tool Postgrinders Complete with Attachments.

No. 316

Wanted
1 Electric Laboratory Oven
Baking Space 12″ x 12″ x 18″
Complete with Automatic Temperature Control and Indicating Pyrometer

If You Have Used or Surplus Machinery For Sale, Write for Details of our Plan. No Charge For Listing.

APPRAISALS ✦ ✦ ✦ STEEL AND NON-FERROUS ✦ ✦ ✦ INSPECTIONS

FOR DETAILS WRITE

Dunscomb Associates

BOX 320, C/O WIRE AND WIRE PRODUCTS 17 EAST 42nd ST., NEW YORK, N. Y.

REGISTRY OF USED WIRE MILL MACHINERY

The Wire Drawing Die

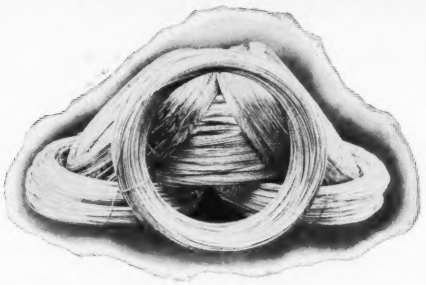
(*Continued from page 200*)

die pull which wire drawers will agree is reasonable, since the friction increases when you use a "slim taper". Actual friction scales about 650. Now we have 38% friction and 62% deforming force in our horizontal pull. I use the same 2 squares for 1680 lbs., or 840 lbs. per big square, and run down the new diagonal until the 62% line fits horizontally between it and the vertical from B. My total force then scales 6560 lbs. This checks the coefficient of friction again at about .10 (650 divided by 6560). Dividing the total stresses, 6560 lbs., by the contact area, .128 square inches, I get an average unit stress of 51,240 lbs per square inch. Something wrong here. We found that this stock wouldn't draw till it was stressed to 51,700 lbs. What this means is simply that a die pull of 1680 lbs will not stress this metal high enough to start flow. Put on a pound more and the wire will break at the die throat. It never will draw. This is no surprise, for an angle of 18 degrees is too small for a 50% draft. Friction has defeated us. The increase in die pull was due to a larger total force operating in the cone. This multiplied by the coefficient gave us a larger total friction and a larger horizontal component of friction, so large that when it was added to the horizontal component of the force needed to deform the steel their total exceeded the strength of the finished wire. All this came from the die angle, and we are justified in suspecting not only that the angle is a most important thing, but that there may be some logical basis for the choice of angles.

The continuation of this study will appear in the August issue of Wire and Wire Products.

ZINC WIRE
ZINC STRIP
EYELETS
THE PLATT BROS. & CO.
WATERBURY, CONN.

SILVER BRIGHT GALVANIZED



We furnish this highly finished galvanized wire to meet your requirements as to coating, tensile strength, bend test, etc. Packed in coils or straightened and cut to length. Our organization will be glad to offer its long experience in wire problems toward the betterment of your product or a reduction in its cost. Call on us.

✦ ✦ ✦

We make a complete line of nails in various sizes and types. Also the following kinds of wire:

BRIGHT BASIC
COPPER-BEARING
ANNEALED
LIQUOR FINISH
TINNED
COPPERED
"GALVANNEALED"
ROPE WIRE
TELEPHONE WIRE
SPRING WIRE
WELDING RODS

KEYSTONE STEEL & WIRE COMPANY
3000 Industrial Street PEORIA, ILL.

The Annual Meeting of the Wire Association

Will be Held at
Detroit, Michigan
October 3, 4, 5, 1933
Headquarters and Technical Meetings at
Book-Cadillac Hotel

In connection with this meeting there will be an exhibition of Wire Mill Machinery and Equipment in Association with

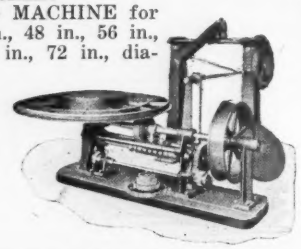
National Metal Congress

For detailed information and space reservations address
RICHARD E. BROWN, Secretary
17 E. 42nd Street New York, N. Y.

"Aimco" PANNING MACHINE (2)

AUTOMATICALLY places RUBBER COVERED WIRE in sheet metal pans for vulcanization, SAVES WAGES OF AN OPERATOR and INCREASES PRODUCTION SPEED of Tubing Machine 25% to 50%.

"Aimco" PANNING MACHINE for pans 40 in., 48 in., 56 in., 60 in., 62 in., 72 in., diameter.



MAGNET WIRE INSULATING MACHINES. WIRE ENAMELING MACHINES. HIGH-SPEED WIRE-DRAWING MACHINES.

EST. 1855 AIMCO INC. 1915

"American" INSULATING MACHINERY COMPANY

REG. U.S. PAT. OFF.

517 West Huntington St.

PHILADELPHIA PENNSYLVANIA U.S.A.

STEELSKIN

REG. U. S. PAT. OFFICE

For High or Low Carbon Wire

WIRE DRAWING SOAPS

Established 25 years.

R. H. MILLER CO., Inc. Homer, N. Y.

Make Your Plans Now
To Attend
THE ANNUAL MEETING
of the
WIRE ASSOCIATION
DETROIT, MICH.—OCT. 3, 4, & 5, 1933

✦ ✦ ✦

Interesting discussions on subjects of general interest to all wire mill men.

✦ ✦ ✦

COME AND PARTICIPATE

✦ ✦ ✦

LOW RATE RAILROAD FARES

For information address

THE WIRE ASSOCIATION
Richard E. Brown, Secretary

17 E. 42nd St. New York, N. Y.

Fatigue Tests of Helical Springs

(*Continued from page 211*)

straight line deflection are quite small and irregular; some being positive and some negative. On the release side they are rather larger and are all positive. This spring showed a solid fiber stress of 87,100 lbs. per sq. in. on test.

✦ ✦ ✦

NOW compare a similar tabulation for Spring "A" of Group Six, showing a solid fiber stress of 115,800. (See Table 5).

AGAIN the variations on the compression side are small and irregular. But on the release side the variations throughout most of the load range are uniformly about .2".

The above examples are entirely typical. Assembling the various phenomena described in this report,—

IN helical compression springs as tested, with a hot set ratio not much greater than unity, the solid fiber stress will be not much in excess of the natural elastic limit in shear,—say 85,000; the torsional modulus will be about 11,750,000, the number of inactive coils about 1.125, and the difference between release and compression deflection readings very small. As the hot set ratio increases, the stress increases, the modulus decreases, the number of inactive coils decreases, and the difference between release and compression deflections increases. At a hot set ratio of 1.75 to 2.00, about the practical limit, the solid stress should be 115,000 to 120,000, the torsional modulus probably about 11,000,000, the number of inactive coils somewhat less than 1.00, and the difference between release and compression deflections a very material amount.

✦ ✦ ✦

WHILE these conclusions can only be considered as tentative in the light of the meagre data thus far assembled, it can be said that they are generally in full agreement with the experience of practical spring men.

WE are now faced with the necessity of developing a working theory to account for these interesting and undoubtedly related phenomena.

C. T. EDGERTON, Chairman,
Sub-committee on Heavy
Helical Springs.

✦ ✦ ✦

A Review of Recent Wire Patents

(*Continued from page 212*)

No. 1,904,343, WIRE DRAWING APPARATUS, Patented April 18, 1933, by Carl R. Hoffman of Berwyn, Illinois, assignor to Western Electric Company, Incorporated of New York, N. Y., a Corporation of New York.

The invention contemplates the provision, in a wire drawing apparatus, of two shafts preferably driven at different speeds and each provided with a driven stepped capstan and a number of individually rotatable idler sheaves, the sheaves on each shaft being arranged to co-operate with the capstan on the other shaft for guiding the wire through the reducing dies interposed between the shafts.

✦ ✦ ✦

No. 1,904,502, PROCESS FOR APPLYING RUBBER TO METAL AND OTHER HARD MATERIALS, Patented April 18, 1933, by Andre Jules Michelin of Paris, France, assignor to Michelin Et Cie, of Clermont-Ferrand, France, a Corporation of France.

The invention includes the application of rubber to wire and is described as a metallic core, a strong metal wire provided with a textile wrapper tightly wound around the core so as to form contacting turns with a rubber coating applied over this wire.

✦ ✦ ✦

No. 1,904,525, CABLE, Patented April 18, 1933, by Frank M. Potter of Rome, New York, assignor to General Cable Corporation of New York, N. Y., a Corporation of New Jersey.

This invention aims to provide an electrical cable which will be particularly resistant to heat, moisture, soil acidity, alkalinity, oxidation and the like. The construction includes the wire conductors with a surrounding sheath of paper for each conductor, a sheath of rubber for each conductor over the paper, a serving of rubberized tape for each conductor over the rubber, a cotton braid saturated with waterproofing material over the tape, a coating of oxidation and moisture-resistant compound containing stearin pitch and asbestine wiped over the braid for each conductor, a valley filling and overall covering of the compound for the assembled conductors, an asbestos braid sheath for the cable over the compound, a waterproofing material and a coat of the compound applied to the asbestos sheath, an oleate impregnated paper sheath, a coating of the compound over the oleate paper sheath, a jute cord serving over the compound and waterproofing material and talc applied upon the jute serving.

✦ ✦ ✦

No. 1,904,526, CABLE, Patented April 18, 1933, by Frank M. Potter of Rome, New York, assignor to General Cable Corporation of New York, N. Y., a Corporation of New Jersey.

Particularly, the invention has to do with service or cutting in cables, that is, cables adapted to be used for connecting consumers' premises with trunk cables and the like and the construction in this case includes a number of wire conductors with a strand in the valley between the conductors, a plastic oxidation and moisture resistant compound over the strand completing the filling of the valleys and a covering over the conductors and filling with a soft wax saturant for the covering and a skin of iron oxide paint over the saturated covering.

✦ ✦ ✦

No. 1,904,427, CABLE, Patented April 18, 1933, by Frank M. Potter of Rome, New York, assignor to General Cable Corporation of New York, N. Y., a Corporation of New Jersey.

It is stated that this cable is particularly well adapted for use as when placed among the limbs of trees where it will be subjected to rubbing or chafing and accompanying moisture. Over the wire conductor is placed a rubber sheath, a wrapping of rubberized tape over the sheath, a fibrous armor over the wrapping, a coating of oxidation and moisture-resistant plastic compound over the armor, the compound containing stearin pitch and asbestine, a sisal cord braid over the plastic coating, a wax saturant for the braid, a pitch finishing compound over the saturated braid, a cotton braid over the finished material, and a skin coating of iron oxide paint over the whole.

✦ ✦ ✦

No. 1,904,547, CORES FOR CABLES FOR COMMUNICATION CIRCUITS, Patented April 18, 1933, by Karl Schumann of Potsdam, Germany, assignor to Siemens-Schuckerwerke Aktiengesellschaft, of Berlin, Siemenstadt, Germany, a Corporation of Germany.

In the manufacturing of cables for communication circuits, it is difficult to obtain for pairs as well as for stranding elements of higher order, uniform values of capacitance. To remedy this, the inventor provides a cable, one particularly for use in telephone communication, having a number of insulated strands, each strand consisting of a core conductor, paper cords wound upon the conductor and paper tapes spirally wound over the cord windings, adjacently located cord winding turns of adjacent cable strands having the same winding direction but different pitch.

✦ ✦ ✦

No. 1,904,873, ELECTRIC CABLE, Patented April 18, 1933, by Oscar Severin Markuson of Hilton, New Jersey, assignor to Western Electric Company, Incorporated, of New York, a Corporation of New York.

This telephone cable construction includes a number of paper insulated conductors of low resistance stranded together with a thin sheath of metal, preferably of lead alloy tape, associated therewith to protect the conductors against electrical inductive interference and to increase the mechanical strength of the cable.

(*Please turn to page 222*)

NEP LIQUID & POWDER
20 Years Success
Pickle Properly
The Wm. M. Parkin Co.
PITTSBURGH, PA.

EFFICIENT PICKLING
REQUIRES "RODINE"
RODINE, SAVES ACID AND METAL.
Prevents over-pickling. Minimizes acid brittleness and acid fumes.
Samples and Directions sent on request.
AMERICAN CHEMICAL PAINT CO.
AMBLER, PA.
Detroit Office & Warehouse 6339 Palmer Ave.; E.

Patents—Trade Marks
All cases submitted given personal attention by members of the firm. Information and booklet free.
Lancaster, Allwine & Rommel
PATENT LAW OFFICES
Suite 438, 815-15th St., N.W. Washington, D. C.

EACH time a man sells his experience, his light shines the brighter, and after a while the world will blaze a trail to his cabin door and loudly call for more of his experience.

W. H. SPOWERS, JR.

W. H. Spowers, Jr.
Consulting Engineer
551 Fifth Ave., N. Y. C.
Specializing in Galvanizing Plants Designed and Installed
Practical Engineering
Vanderbilt 3-7395 Advice

OTTO F. JAGIELSKI
Consulting Engineer
167 RADFORD ST., YONKERS, N. Y.
Specializing in manufacture of insulated wire and cable.
Modern equipments and plants designed and installed.
Development work on new machinery, methods and processes.
Practical engineering advice from rod mill to finished product.
Phone: Yonkers 3727

Kenneth B. Lewis
CONSULTING ENGINEER
Wire Mill Equipment, Layout and Practice
17 East 42nd St. New York City
Phone: Murray Hill 2-4188
43 Midland St. Worcester, Mass.
Phone 5-6033

Broden Construction Co.
Wire Mill and Cold Rolling Equipment
10255 Harvard Ave.
CLEVELAND, OHIO

WIRE MILL EQUIPMENT
MORGAN CONSTRUCTION CO.
WORCESTER, MASS.

Wire Mill Equipment, Stranding, Insulating, Drawing, Welding
Thomson-Judd Wire Machinery Co.
Subsidiary of
Thomson-Gibb Electric Welding Co.
Lynn, Massachusetts.

PATENTS

(*Continued from page 221*)

No. 1,904,887, ELECTRIC CABLE, Patented April 18, 1933, by Parke Lawton Shee of Berwyn, Illinois, assignor to Western Electric Company, Incorporated of New York, N. Y., a Corporation of New York.

In this invention, as applied to submarine cables the conductors along a comparatively short portion of the stranded cable core length are separated from each other to provide open convolutions. This portion of the cord is then treated with a water-proofing compound of a consistency which will thoroughly impregnate and water-proof the paper insulating material after which the portion of the core having the treated and separated conductors is provided with a composition, preferably containing an artificial resin such as a phenolic condensation product which is inserted around the conductors to fill the space.

✦ ✦ ✦

No. 1,905,459, SPRING ASSEMBLING MACHINE, Patented April 25, 17933, by John F. Gail of Evanston, Illinois, assignor to Simmons Company of New York, N. Y., a Corporation of Delaware.

Particularly, the machine is one adapted for assembling and connecting coil springs employed in the manufacture of bed springs, cushions, mattresses and the like. By the use of this machine, the wire helicals may be threaded thru the end coils of adjacent rows of spiral springs and the connected rows shifted sidewise and a succeeding row brought into proper position to be similarly united to the last attached row.

✦ ✦ ✦

No. 1,905,648, COATED WELDING WIRE, Patented April 25, 1933, by Robert Notvest of Indianapolis, Indiana, assignor to J. D. Adams Manufacturing Company of Indianapolis, Indiana, a Corporation of Indiana.

The coating composition for the welding wire comprises approximately 55 parts of ferric oxide and 45 parts by weight of silica, a binder composed of sodium silicate and water and sufficient calcium carbonate to render the coating composition neutral.

✦ ✦ ✦

No. 1,905,789, INSULATED ELECTRICAL CONDUCTOR, Patented April 25, 1933, by Anthony A. Benner and Rudolph A. Schatzel of Rome, New York assignors to General Cable Corporation, of New York, N. Y., a Corporation of New Jersey.

This cable construction includes a wire conductor having an insulating covering interwoven fibrous strips and binding threads and a wrapped strip of fibrous material, a longitudinal wrapping of crepe paper and a jacket for the whole.

WIRE DRAWING MACHINERY AND EQUIPMENT
Rod Frames—16″ Frames, 8″ Frames —Take-Up Frames, Wire Pointers—Puller Tongs.
General Castings for Wire Mill use.
Circulars on Request.
E. J. Scudder Foundry & Machine Co.
Trenton, N. J.

WIRE STRAIGHTENING AND CUTTING MACHINERY
FOR ALL SIZES, SHAPES AND KINDS OF WIRE
The F. B. Shuster Co.
New Haven, Conn.
Straightener Specialists Since 1866

JOHN ROYLE & SONS
PATERSON, NEW JERSEY.
MAKERS OF EXTRUDING MACHINES FOR COVERING ELECTRIC CONDUCTORS AND WELDING WIRE

Wire Drawing Diamond Dies
COCHAUD WIRE DIE CORPORATION
300 W. 56th ST., NEW YORK
Tel. Col. 5-1340

VIANNEY
Famous Wire Drawing Diamond Dies
250 EAST 43rd ST., N. Y. CITY

BUYERS' GUIDE

For more complete information, consult the annual Directory, Index & Buyers' Guide.

ACID RESISTING PIPES AND FITTINGS
Haveg Corporation, Newark, Del.

ANNEALING FURNACES
See Furnaces—Various Headings

ANNEALING POTS AND BOXES
National Wrought Iron Annealing Box Co., Washington, Pa.
Scudder, E. J., Fdry & Machine Co., Trenton, N. J.

ARMORING EQUIPMENT
Amer. Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

BAKERS
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CASTINGS—Wire Mill
E. J. Scudder Foundry & Machine Co., Trenton, N. J.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.

CHROME NICKEL—Construction
National Wrought Iron Annealing Box Co., Washington, Pa.

CLEANING & PICKLING EQUIPMENT
Broden Construction Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

COILERS—Sheet and Wire
H. J. Ruesch Machine Co., Newark, N. J.

CRANES—Wire Mill
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

DIES—Composition
Vianney Wire Die Works, New York, N. Y.

DIES—Diamond
Balloffet Diamond Wire Dies Co., Inc., N. Y. C.
Cochaud Wire Die Co., New York.
Driver-Harris Co., Harrison, N. J.
Vianney Wire Die Works, New York.

DIES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Balloffet Diamond Wire Dies Co., Inc., N. Y. C.
Cochaud Wire Die Corp., New York.
Driver-Harris Co., Harrison, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
Vianney Wire Die Wks., N. Y.

DIES—Recutting and Repolishing Machine
Vianney Wire Die Works, New York, N. Y.

DIES—Rod and Tube Drawing
Carboloy Co., Inc., Newark, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
Master Wire Die Co., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tantalum Carbide
Vianney Wire Die Works, New York, N. Y.

DIES—Tungsten Carbide
Carboloy Co., Inc., Newark, N. J.
Driver-Harris Co., Harrison, N. J.
Master Wire Die Co., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DRAW BENCHES—
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry & Machine Co., Trenton, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

ENGINEER—Consulting Wire Mill
Jagielski, Otto, Yonkers, N. Y.
Lewis, Kenneth B., New York, N. Y.

EYELETS—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FURNACES—Annealing
Electric Furnace Co., Salem, O.

FURNACES—Automatic
Electric Furnace Co., Salem, O.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, O.

FURNACES—Electric
Electric Furnace Co., Salem, O.

FURNACES—Lead Melting
Electric Furnace Co., Salem, O.
John Robertson Co., Brooklyn, N. Y.

FURNACES—Non-Oxidizing
Electric Furnace Co., Salem, O.

GALVANIZING ENGINEER
W. H. Spowers, Jr., New York, N. Y.

FURNACES—Wire
Electric Furnace Co., Salem, O.

GALVANIZING KETTLES—
National Wrought Iron Annealing Box Co., Washington, Pa.

INHIBITORS—
American Chemical Paint Co., Ambler, Pa.
Wm. M. Parkin & Co., Pittsburgh, Pa.

LATHES—Die Reaming
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LIME—Pulverized
Amer. Lime & Stone Co., Bellefonte, Pa.

LUBRICANTS—Wire Drawing
R. H. Miller Co., Homer, N. Y.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
John Robertson Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
New England Butt. Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Bunching
Amer. Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Machinery Co., Philadelphia, Pa.
Fred'k M. Conran, Newark, N. J.
New England Butt Co., Providence, R. I.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

MACHINERY—Chain Making
Fred'k M. Conran, Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

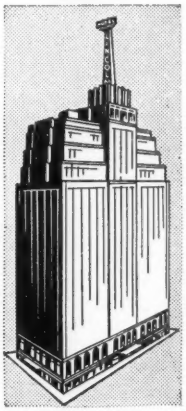
MACHINERY—Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Fred'k M. Conran, Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Coilers
Broden Const. Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

IN THE HEART OF NEW YORK

TO STAY AT THE LINCOLN . . . IS A HAPPY REMEMBRANCE



An interesting cosmopolitan atmosphere . . Cheerful Rooms . . Pleasant Service . . Fine Restaurants Moderately Priced . . Around the corner are theatres, clubs and glamorous Times Square . .

Conveniently accessible to railroad terminals, steamship piers, the business and shopping centers . .

"A Perfect Hotel for The Visitor"

ROOM *with* PRIVATE BATH, RADIO *and* SERVIDOR

$2.50 *single per day* $3.50 *double per day*

Special weekly and monthly rates.

HOTEL LINCOLN

44th to 45th Sts.—8th Ave.—New York

JOHN T. WEST, General Manager

BUYERS' GUIDE, Continued

MACHINERY—Copper Wire Drawing and Rolling
Kratos-werke Aktiengesellschaft Gruna 1. SA. Germany
H. J. Ruesch Machine Co., Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cutting
Broden Construction Co., Cleveland, O.
F. B. Shuster Co., New Haven, Conn.
Sleeper & Hartley, Worcester, Mass.

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.

MACHINERY—Extruding
John Robertson Co., Brooklyn, N. Y.
John Royle & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Forming
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
H. J. Ruesch Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Insulating
American Insulating Machinery Co., Phila.
New England Butt Co., Providence, R. I.
John Royle & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lead Encasing Presses, etc.
John Robertson Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Measuring Wire & Cable
Lyon Measuring Machine Division of Barbour Welt'ng Co., Montello, Mass.
New England Butt. Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Machinery Co., Phila.

MACHINERY—Pointing
Broden Construction Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
Morgan Const. Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Lewis F'dry & Machine Co., Pittsburgh, Pa.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
Lewis F'dry & Machine Co., Pittsburgh, Pa.
Morgan Construction Co., Worcester, Mass.
H. L. Reusch Machine Co., Newark, N. J.

MACHINERY—Rubber Strip Covering
John Royle & Sons, Paterson, N. J.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
John Royle & Sons, Paterson, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila Pa.
Broden Construction Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry and Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spooling
American Insulating Machinery Co., Phila.
Fred'k M. Conran, Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening Hollow Wire
Fred'k M. Conran, Newark, N. J.

MACHINERY—Stranding
Fred'k M. Conran, Newark, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Const. Co., Clevelahd, O.
Fred'k M. Conran, Newark, N. J.
Lewis F'dry & Machine Co., Pittsburgh, Pa.
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Swaging
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Worcester, Mass.

MACHINERY—Taping
Amer. Insulating Mach. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

MACHINERY—Tinsel Rolling Mills
Amer. Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
Fred'k M. Conran, Newark, N. J.
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Welding Wire
F. B. Shuster Co., New Haven, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Insulating Machinery Co., Phila.
Broden Const. Co., Cleveland, Ohio.
Fred'k M. Conran, Newark, N. J.
Kratos-werke Aktiengesellschaft Gruna 1. SA. Germany
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

PACKING—Metallic Fibre
Hudson Wire Co., Ossining, N. Y.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.

PICKLING AND PLATING TANKS
Haveg Corporation, Newark, Del.

MACHINERY—Wire Tinning
American Insulating Mach'y Co., Phila., Pa.

POTS—Lead Melting
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead Encasing
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
E. J. Scudder Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

REELS AND SPOOLS—All Kinds
R. B. Hayward Co., Chicago, Ill.

REEL AND TENSION STAND—
Sleeper & Hartley Inc., Worcester, Mass.

REEL CRUTCHES
R. B. Hayward Co., Chicago, Ill.
Watson Machine Co., Paterson, N. J.

ROLLING MILLS—See Machinery—Rolling Mill

ROLLS—
Lewis F'dry & Machine Co., Pittsburgh, Pa.

SOAPS—Wire Drawing
Drakenfeld & Co., B. F., New York, N. Y.
R. H. Miller Co., Homer, N. Y.

SPOOLS—Aluminum Alloy
Lestershire Spool Co., Johnson City, N. Y.

STEEL PLATE CONSTRUCTION—
National Wrought Iron Annealing Box Co., Washington, Pa.

STRIP—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

TANKS—Compound
Haveg Corporation, Newark, Del.
Watson Machine Co., Paterson, N. J.

TANKS—Steel Plate
National Wrought Iron Annealing Box Co., Washington, Pa.

TRUCKS
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS
H. J. Ruesch Machine Co., Newark, N. J.

VULCANIZERS
John Royle & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS
American Insulating Mach'y Co., Phila., Pa.

WIRE—Enameled For Coils
Winsted Insulated Wire Co., Winsted, Conn.

WIRE—Manufacturers
Keystone Steel & Wire Co., Peoria, Ill.

WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Non Ferrous to Specification
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.
Winsted Insulated Wire Co., Winsted, Conn.

WIRE—Steel—Also Coppered Steel—Also Glavanized Steel
Keystone Steel & Wire Co., Peoria, Ill.

WIRE AND STRIP—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

This is a carefully classified index of concerns who specialize in this industry and who advertise regularly in WIRE & WIRE PRODUCTS. Please mention WIRE when writing to these firms.

THE WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

Electric Cable and Wire Rope Machinery:

STRANDERS	Planetary & Rigid Frame types (*horizontal and vertical.*) High-Speed Tubular and Built-up types.
BUNCHERS	High-speed types for spools up to 1500 lb. capacity.
ARMORING MACHINES	For Wire (*planetary type*) and for Tape.
PAIRING & TRIPLING MACHINES	For Bare & Insulated Wire.
CLOSERS	For Wire in Planetary, High-speed & Angular types.
CLOSERS & CABLERS	For electric cable in Planetary and Angular types.
TAPING MACHINES	Eccentric and Concentric types, for Paper, Friction and Varnished Cambric and Burlap types.
TAPING HEADS	For applying steel tape in Eccentric and Concentric high-speed types.
JUTE & BURLAP	Applying Heads.
THREAD SERVERS	For Cotton, Asbestos, etc. application on hose and wire.
COMPOUND TANKS	Electrical or Steam heated for machine or unit application.
CHALK APPLIERS	Wet and Dry types.
CAPSTAN SECTIONS	With Single tapered and double grooved wheels, with Lay Control by gears of variable speed transmission.
LET OFF REEL STANDS	Shaft and Shaftless types, for any size of reels.
WINDERS	For steel and copper, in single or multiple head units.
COILING MACHINES	Power or manual drive for package coiling—also for warehouse and shipping room use.
COILING HEADS	For wire rope and insulated wire and cable.
TAKEUP STANDS	Inclined frame, Shaftless and Heavy-duty types.
TRAVERSES	Light and Heavy, manual, mechanical and motorized.
TEMPERING & GALVANIZING MULTIPLE HEAD TAKEUPS	For wire.
MEASURING MACHINES	For Length Measurement.
ELECTRIC PATCH VULCANIZERS	
SATURATING, WAXING & GREASING TANKS	Gas fired and Electrical.
WIRE TINNING MACHINES	Gas fired and Electrical.
CABLE PEELERS	For removing lead sheathing and insulation.
POLISHING HEADS	Separately or Motor driven.
REEL CRUTCHES	For turning heavy reels in handling and shipment.
MOTORIZED WINCHES	For general duty in cable and rope plants.
CUTTERS	For wire rope, cable and chain.
SPOOLS	Heavy-duty for Rope-Mills and Cable-plants.

Send for descriptive catalogue.

ELECTRICAL WIRE AND CABLE—WIRE ROPE AND CORDAGE MACHINERY

FURNACES for HEATING and HEAT TREATING Without Scale

Continuous BRIGHT ANNEALING FURNACES

For Ferrous and Non-ferrous Metals - - the Material Comes Out Bright, Clean and Dry.

Continuous FURNACE BRAZING

The Efficient and Economical Method of Joining Metal Parts

FURNACES for DEOXIDIZE ANNEALING Using Our New Inexpensive Furnace Gas

NEW DEVELOPMENTS

We have developed an inexpensive furnace atmosphere which will bright anneal, normalize and deoxidize anneal steel in a continuous furnace. Sheet, strip, tubing, stampings, semi or finished parts, etc., can be bright annealed, deoxidize annealed or bright normalized in this type of equipment.

Silver, copper, nickel-silver, red brass, in sheet tubing, coils, straight lengths or wire is delivered from the furnace bright and dry.

The most intricate steel parts or assemblies are brazed and delivered from the furnace continuously.

Pickling and acid embrittlement are eliminated. The surface of the metal is superior to a pickled surface.

Our engineering department will be glad to consult with you, submit samples of our work and complete operating costs.

THE ELECTRIC FURNACE CO.

SALEM, OHIO.

Fuel Fired Furnaces

Electric Furnaces